Summary Minutes of the United States Environmental Protection Agency (U.S. EPA)
Science Advisory Board (SAB) Meeting
February 28, 2008 & February 29, 2008

Board Members: See Board Roster provided in Attachment A.

Date and Time: Thursday, February 28, 2008, 8:30 a.m. - 5:30 p.m.
Friday, February 29, 2008, 8:30 a.m. - 1 p.m.

Location: Westin Arlington Gateway
801 N. Glebe Road
Arlington, VA 22203

Purpose: The purpose of this meeting was to discuss the U.S. EPA research budget for FY 2009, review a draft SAB report, and conduct other business as time permitted. The Agenda is in Attachment B and the *Federal Register* announcement of the meeting is in Attachment C.

Attendees:

Chair:	Dr. Granger Morgan	
Members:	Dr. Henry Anderson (Liaison)	Dr. Jill Lipoti
	Dr. Thomas Burke	Dr. Michael J. McFarland
	Dr. James Bus	Dr. Rebecca Parkin
	Dr. Deborah Cory-Slechta	Dr. Stephen M. Roberts
	Dr. Virginia Dale	Dr. Joan Rose
	Dr. Kenneth Dickson	Dr. James Sanders
	Dr. David A. Dzombak	Dr. Jerald Schnoor
	Dr. James K. Hammitt	Dr. Kathleen Segerson
	Dr. Steven Heeringa (Liaison)	Dr. Kristen Shrader-Frechette
	Dr. Rogene Henderson	Dr. Deborah Swackhamer
	Dr. James H. Johnson	Dr. Thomas L. Theis
	Dr. Bernd Kahn	Dr. Valerie Thomas
	Dr. Agnes Kane	Dr. Barton Thompson, Jr. (by phone)
	Dr. George Lambert	Dr. Lauren Zeise

A list of additional attendees is in Attachment D.

Meeting Summary:

Discussion at the meeting generally followed the issues and timing as presented in the meeting agenda (Attachment B).

Thursday, February 28, 2008

Convene Meeting

Mr. Thomas Miller, SAB DFO, convened the meeting and welcomed the group. He noted that the SAB is required to comply with all Federal ethics and conflict of interest codes. Mr. Miller stated that the topics discussed at this meeting were not specific party nor particular matters, and therefore did not pose ethical or conflict of interest issues. He remarked that one important component of the Federal Advisory Committee Act (FACA) is public access and participation; two written public comments submitted for the meeting would be shared with the group in the afternoon when the topic was discussed.

Welcome

Dr. Vanessa Vu, the SAB Staff Office Director welcomed the group, and thanked the U.S. EPA and contractor staff. Dr. Vu noted that the SAB members would be notified of the date for the Congressional Hearing concerning EPA's fiscal year (FY) 2009 budget.

Introduction of SAB Members & Meeting Purpose and Approach

Dr. Granger Morgan, the SAB Chair, recognized Dr. David Dzombak for his recent election to the National Academy of Engineering.

In opening the meeting, Dr. Morgan noted that regular reviews of the budget had become overly detailed. As a result, the SAB has now separated its strategic consideration of the research program from the budget review. The strategic review was initiated during the SAB's October 2007 meeting and it will continue in the future as a series of interactions between the Board and the Agency. Dr. Morgan provided an overview of the agenda for the meeting (see Attachment B).

Overview of Federal Research Budgets for FY 2009

Dr. Kei Koizumi, member of the R&D Budget and Policy Program staff for AAAS, presented background information on the AAAS and trends of the Federal research budget, which makes up about one-third of the Federal budget (see Attachment E). Dr. Koizumi noted that during the current decade, there have been increases in discretionary spending, primarily on the defense side. He stated that more is currently being spent on non-defense discretionary items then at the end of 1990s, but spending has been flat, since 2004. Dr. Koizumi noted the spike in R&D investment at the National Institutes of Health (NIH) in biomedical science in the late 1990s and early 2000s. As for environmental science, investments there have been flat. Since early 2000, funding for life sciences has been declining. In addition, Dr. Koizumi noted that overall spending for the Federal climate change science program has declined.

Dr. Koizumi noted that there are budgetary increases for most R&D programs in 2009 with several exceptions (e.g., NIH) will be flat and agriculture and environmental R&D funding will decrease). Twenty-four agencies invest in R&D, investing over $145 billion. Defense spending

is now 57 percent of total R&D spending. R&D efforts in civilian agencies are focused primarily on research.

Major themes in the R&D funding include, the America Competitiveness Initiative, basic research in the physical sciences and engineering, large increases for DOD weapons and general research and increases for NASA spacecraft development. Spending in the area of natural resources and the environment has been steady for several decades. However, decreases in spending from FY 2008 (by percentage) are largest for environment and agriculture. Dr. Koizumi noted that environmental R&D faces a tough scenario due to tight domestic spending limits and competition from the space program and life sciences. He remarked that Congress has tried to boost funding for environmental programs, but in the last two years, Congress has not been able to increase appropriations.

Dr. Koizumi said that U.S. EPA is supporting R&D in life sciences and environmental sciences; however, with a budget of less than $500 million, it is a niche investor. The U.S. EPA's R&D budget has decreased in comparison to other agencies.

Agencies funding environmental R&D in addition to EPA include the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the Army Corps of Engineers, the U.S. Forest Service in the U.S. Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), and the U.S. Department of Energy (DOE) (the total environmental R&D spending is $8 billion though much of this may not be of direct use to EPA).

Members of the SAB asked Dr. Koizumi several specific questions about the FY 2009 Federal research budgets. Questions and comments focused on:

a) The ratio of public to private environmental R&D spending. Dr. Koizumi said that it is difficult to characterize spending for specific sectors, however the health sector can be categorized as follows: approximately 2/3 industry and 1/3 Federal government spending. He added that it is difficult to define environmentally focused industry R&D. When it comes to research, the Federal government tends to contribute to our knowledge of the earth and the environment, while industry provides the technologies.
b) Extent of state government cuts to R&D spending. This is also very difficult to provide definitive information on state R&D spending. Dr. Koizumi has received anecdotal reports that state governments are increasing spending in life sciences and industrial technologies, but he has not heard anything on states increasing environmental and agricultural spending with the exception of California.

c) EPA and the Department of Defense (DoD) have roughly the same amount of money allocated for environmental R&D. What are the components of the DoD environmental program? Dr. Koizumi replied that much of the R&D money is devoted to cleanup missions, primarily developing remediation technologies. He also noted that the DoD invests a large amount of money in ocean sciences for the Navy and its strategic environmental research program.

d) Has EPA changed its human health protection role for human health following disasters, especially after hurricane Katrina? Trends in U.S. EPA's R&D budget are roughly in line with what has been seen in other years (i.e., there has not been a large shift for human health protection after Katrina). Dr. Koizumi stated that larger changes were made in response to the anthrax incidents.

e) What is included in the industrial component of health? Dr. Koizumi replied that it is comprised of the pharmaceutical and biotechnology industries, which contribute about $60 billion to R&D, compared to NIH, which invests $30 billion.

f) How does environmental spending in the United States compare to that of other countries? Dr. Koizumi responded that the data available provide a single value for environmental and health spending. Using this single value, the United States is dominant due to its large investment in NIH; however, if environmental spending were considered independently, the United States' investments would not be as competitive.

g) Members of the SAB expressed concern that the Federal water monitoring conducted by USGS would be negatively affected by budget cuts to that agency. Dr. Koizumi replied that reductions in spending would be in minerals, then in water programs. Dr. Koizumi stated that details of the USGS budget cuts are available on AAAS' website.

Dr. Morgan thanked Dr. Koizumi for his presentation.

Overview of the U.S. EPA FY 2009 Budget

Mr. David Bloom, the U.S. EPA/Office of the Chief Financial Officer (OCFO), Office of Budget Director, provided an overview of the total EPA 2009 Budget request. EPA's request is for $7.14 billion for FY 2009 compared to $7.20 billion in FY 2008. He asserted that the 2009 budget request will keep U.S. EPA in line to meet its environmental goals.

The science and technology (S&T) account across U.S. EPA experienced an increase in appropriations (though the ORD portion of S&T decreases by nearly $7 million). The following U.S. EPA efforts were among those that experienced an increase in funding in the FY2009 budget: the Superfund program, energy permitting, homeland security, brownfields, and import safety. In general, operating programs experienced a decrease in appropriations.

Mr. Bloom highlighted other changes in the non-research budgets (see Attachment F).

Ms. Laura Palmer noted that between 2007 and 2009, there was approximately a 4 percent decrease in research funding. She explained that ORD and the Office of Air and Radiation (OAR) comprise 82 percent of the U.S. EPA's S&T budget. S&T funding includes $11 million for water security pilot projects, $2.1 million for decontamination research, and $2.7 million for research on renewable fuel standards.

Ms. Palmer provided highlights from the U.S. EPA ORD FY 2009 S&T budget. He noted that there is a lot of focus on emerging issues such as nanotechnology, decontamination programs, and computational toxicology. Ms. Palmer remarked that the President's budget does not carry forward funding for global change research, future green house gas rulemaking, increases to drinking water research, and human health and ecosystems research.

Question and Answer Session on the U.S. EPA FY 2009 Budget:

Members of the SAB asked Mr. Bloom and Ms. Palmer several specific questions about the FY 2009 EPA research budgets. Questions and comments focused on:

a) U.S. EPA's funding priorities: Mr. Bloom fielded questions about the reductions in funding for the following areas: global change research, future green house gas rulemaking, drinking water research, and human health and ecosystems research. Members asked if global change resources had been transferred to homeland security. Mr. Bloom responded that the budget reflects difficult choices made within a tight budget environment. He noted that often the Congress will respond to the budget with appropriations that reflect their own priorities. Mr. Bloom confirmed that homeland security did receive the bulk of funding increases.
b) Prevention vs. Enforcement: A member asked if the Agency had considered funding prevention activities instead of increasing resources for enforcement. Funding appears to have been taken from other programs to pay for increased enforcement, increased prosecution, and responding to threat requests.

Overview of the U.S. EPA FY 2009 Research Budget

Dr. Kevin Teichman, U.S. EPA ORD Deputy Assistant Administrator for Science, presented an overview of the EPA Research Budget for FY 20009 (see Attachment G). Dr. Teichman noted that even now, ORD is planning for FY 2010 and that suggestions made at this meeting will influence development of the 2010 FY budget.

Dr. Teichman presented a slide comparing the FY 2009 budget to the budgets going back to1999. The graphic presents information in nominal dollars and in 1999 constant dollars. Dr. Teichman noted that there were no earmarks in the 2007 budget, but approximately $5 million of earmarks in the 2008 budget.

Dr. Teichman noted that the FY 2009 budget requests increases in funding for: land restoration, Superfund clean up, nanotechnology, homeland security, human health risk assessment, pesticides, and toxicology research. Much of the increase for homeland security intended for research on anthrax. Dr. Morgan asked if the Agency had considered studying other infectious agents. Dr. Teichman responded that anthrax is one of the most potent agents known; therefore, focusing research on this agent effectively prepares us for worst-case scenarios.

The human health risk assessment increase continues to ramp up the support for the Integrated Risk Information System (IRIS) and the increase for pesticides and toxics is directed at assessing

the toxicity of agents to terrestrial organisms in support of risk assessments for wildlife and plants.

Funding decreases are in the areas of: drinking water, endocrine disruptors, global change, biotechnology, human health and ecosystems, fellowships, and sustainability. The reduction in funding for the drinking water programs is possible because the disinfection by-product work is complete. Dr. Teichman added that these funds are being redirected into asbestos research and recreational water quality criteria efforts. Funding decreases in endocrine disruptors research reflects completion of development of tier one testing methods. Fellowships will be reduced by $1 million and sustainability will see a reduction of $2.2 million.

Dr. Teichman also discussed ORD's Planning and Budgeting process, the role and activities conducted by National Program Directors (NPDs) in that process and examples of ORD's key strategic research Directions. He noted that several organizations and review processes influence ORD's strategic planning, including activities conducted under the PART process, activities of the BOSC, and interactions with the SAB, as in the strategic research directions review that was initiated in October 2007 and which is envisioned as a continuing activity into the future.

In discussing how ORD views the nature of its work, Dr. Teichman noted that past conceptions such as basic research vs. applied research and core research vs. program-driven research, have given way to a more realistic categorization for ORD of cross-program and program-targeted research. ORD believes this is a more productive way of discussing the issue raised last year in the context of "Cross-Cutting" issues (e.g., global change, sensitive populations, urban sprawl, and environmental disasters). Though difficult to define, cross-program research has a broad application and implications for multiple program offices. Cross-program research applies emerging approaches and tools to issues, and serves as an incubator for innovative thinking about long-standing issues. In this category, priorities remain relatively stable, and the approach permits the incubation of new ideas. In selecting stressors to address in its cross-program research, ORD consciously considers those that will also provide information for program-targeted issues. Alternately, program-targeted research is often conducted for a single or a primary client. It might also be legislatively mandated and have specific deadlines for its completion. Here, priorities often shift based on changing program needs. Often the research is conducted using established methodologies. He noted that some programs would be difficult to put into either category (e.g., computational toxicology).

It was noted that the National Program Directors developed documents prioritizing their research programs based on scientific and Agency needs rather than budget. These documents are available in the public domain.

Question and Answer Session on the U.S. EPA FY 2009 Research Budge:

a) Research to identify ecological impacts and encourage sustainability. Members noted that last year the SAB suggested that ecosystems should be valued more holistically and that impacts should not be limited to human benefits. At a minimum, ecological impacts that affect humans should also be considered. One SAB member noted that while identification of metrics for sustainability is difficult, it is critical.

b) EPA employee retention and morale was discussed. Dr. Teichman noted that approximately one-third of post-doctoral researchers remain with the Agency following their fellowship. SAB members suggested that U.S. EPA examine ways to further increase the retention rate of post-doctoral researchers. In regard to staff morale, Dr. Teichman noted that U.S. EPA's Research Triangle Park Campus was named the third best place to work for post-doctoral researchers and that 70 percent of ORD staff indicate they are happy with their jobs. He noted that numbers for other agencies were not available, but information regarding U.S. EPA as a whole should be available. One SAB member requested that job satisfaction data for scientific and administrative staff be considered separately. Dr. Teichman noted that U.S. EPA is working to restructure their administration to address increasing personnel costs.

General Discussion of the U.S. EPA Research Budget Priorities

The SAB members, ORD representatives, and regional and program office representatives discussed the U.S. EPA research budget priorities, and Dr. Teichman fielded their questions.

a) Land protection and restoration: Is this funding Congressionally mandated to have a limited focus? Dr. Teichman replied that the Superfund portion of the budget can be used only for Superfund; however, within the hazardous waste portion of the budget, there is some flexibility. He noted that working with nanotechnologies and asbestos is the highest priority in this area. Dr. Teichman noted that U.S. EPA Superfund program is technology based, and develops new engineering technologies to improve cleanups.
b) Members pointed out the continuing need for research and technical support to EPA Regional Offices. A member asked how much of the overall the U.S. EPA S&T budget was devoted to research at a regional level. Dr. Teichman estimated that a large amount of the U.S. EPA's budget would go to the U.S. EPA Regions.
c) Behavioral and social sciences. There is a need for this research, in addition to economics research that has seen significant decreases in the last two years. Dr. Teichman replied that environmental decision science work is no longer in the ORD budget. However, some social science is contained within homeland security, such as the challenge of communicating risk.
d) Referencing slide 6 of Dr. Teichman's presentation, one member observed that the budget is shrinking and that the graph suggests that the program appears unsustainable. A greater percentage of ORD's budget is in personnel compensation and benefits and asked if ORD was expecting an upcoming staff shortage. Dr. Teichman noted that a 1.1 percent reduction in staff was expected. With the U.S. EPA 2 percent attrition rate, this means they plan to backfill one employee for every two that leave. Dr. Teichman acknowledged this as a challenge and said that U.S. EPA is investigating hiring strategies and approaches to make the budget go further.
e) One SAB member remarked that long-term planning would be necessary to sustain intramural projects and that access to staff with varying expertise will be necessary to build new programs. Dr. Teichman responded that U.S. EPA first tries to define its research areas, and then address staffing needs. He stated that the Agency conducts workforce planning to determine staff needs for emerging areas. He remarked that

research could always be done extramurally if the U.S. EPA does not have the appropriate staff.

Concurrent Breakout Sessions to Discuss FY 2009 Research Budgets for Specific Research Programs

The SAB members, ORD representatives, and regional and program office representatives divided for breakout sessions. For the preliminary breakout group participant list, see Attachment H. These sessions continued after lunch. The results of the discussions in breakout session are captured in the draft materials that were assembled as SAB comments on the FY 2009 budget that are discussed later in these minutes.

Overview and Update on the SAB Project on Valuing the Protection of Ecological Systems and Services

After lunch, the breakout sessions were interrupted for a short period to allow the Board to receive an update on the SAB project on Valuing the Protection of Ecological Systems and Services (see Attachment I). Dr. Barton Thompson, Chair, SAB/Committee on Valuing the Protection of Ecological Systems and Services (CVPESS), stated that the SAB had contributed a significant effort in developing the draft project report. He said that the draft being developed is an interdisciplinary effort, reflecting interviews with U.S. EPA managers and staff and reviews of case studies. The draft report is different from earlier studies on ecosystem ~~e~~valuation in two main ways: the report focuses on the U.S. EPA's needs for improved valuation and it takes a multidisciplinary approach. The report does not just consider economic valuation; instead, it examines non-traditional economic evaluations that do not produce monetary values.

Dr. Thompson provided an overview of recommendations contained in the report. An early draft of the report was sent to several reviewers for an informal review, and is currently being revised based on these initial comments. A revised final draft of the report will be given to the SAB in May 2008. A lay-person version of the report will be prepared and it will be supplemented by a Web site with additional information on valuation methods. He asked the SAB to provide their thoughts on communicating findings to other agencies and experts, and what type of research initiatives should be taken to address gaps in the report.

Member questions and comments included:

a) The extent of the document's coverage of non-economic methods of valuation. A chapter is devoted to other valuation methods, including their potential uses and limitations. He noted that there is also a chapter examining how economic valuation and other methods can be applied to certain case studies. The materials on the internet will include economic and non-economic techniques.
b) Site-specific applications of this report are pretty clear (i.e., ecological risk assessments and environmental impact assessments). What other applications are contemplated? National rulemaking require an assessment, including a cost benefit analysis. This will help the U.S. EPA with valuation of the ecological benefits of a rule.

c) A member noted that the report recommendations discussed earlier appear to be somewhat noncommittal to methods. Dr. Thompson replied that the report suggests an overall approach for valuing ecological systems, which is a conceptual model. The report does not recommend a single method because the authors did not think this was appropriate. Instead, the report lists a variety of approaches for valuation and provides advantages and disadvantages for each method.

Report Out from Breakout Sessions

The breakout groups shared the results of their discussions during the breakout session. For written comments from the breakout sessions, see Attachment J.

Clean Air (Dr. Henderson) and Global Change Research (Dr. Schnoor):

This breakout group reported that the air program has been very successful in providing high-quality information in support of the NAAQS program and has been effective in its interactions with other agencies. Members stated that EPA's successful program in this area was moving in the right direction. Because the budget remains essentially flat the group encouraged EPA to continue and expand program funding.

The group stated that the global change program is doing well in the face of declining funds because of its interactions with partner agencies. Members encouraged the Agency to consider different metrics to assess the program's efficiency and not just measures of green house gas emission changes. Members noted that EPA's budget in another appropriations area (State and Tribal Assistance Grants – STAG) will influence the ability of EPA and its partners to conduct air quality monitoring. The decrease in STAG grants for this purpose, and the increase in the state's requirement for matching funds, (a 40 percent match from states) will jeopardize the monitoring program. Given the budget problems states are having, this increase to matching funds will likely result in a loss of monitoring.

Economics (Dr. Hammitt) and Sustainability (Dr. Theis):

The breakout group noted that economic decision science in no longer a part of ORD, and that the transfer of the program to the National Center for Environmental Economics has resulted in a collapse of the resource levels, meager as they were in the past, to even lower levels ($2 million to currently $600 K). The group saw large needs in the areas of ecosystem service valuation and valuation of mortality risk reduction. EPA's investment is trivial in the area of behavioral research and this is surprising because EPA's mission is, in essence, action that intends to change behavior.

The breakout group said that the U.S. EPA sustainability program's strategy (i.e., a focus on developing tools for sustainable technologies) have spread throughout the Agency. Resources are decreasing which in some ways should be expected if the program is meeting its objectives. It seems ironic when environmental problems are more Regional and global now that the tools being used are not at such a scale. The energy bill passed in December, which called for U.S. EPA to be the lead agency for biofuels assessment, presents EPA with a big opportunity for

application of the technology tools for sustainability that it has under development. The energy bill was passed without any additional funding; therefore, members suggested that EPA ask for funding for the sustainability program.

Ecosystems, Water, and Security Research (Dr. Swackhamer):

The breakout group did not have any major issues with the choices in this area of the FY 2009 budget and felt that the difficult choices made by EPA in the face of decreasing resources aligned with the Agency's priorities in this area. It was stressed that given the budgetary decisions that have been made, the breakout group was impressed with the actions of program managers. The group noted that it is necessary for EPA to get out in front of emerging issues. The breakout group encouraged the inclusion of the stressor of climate change in all research activities. In addition, the group encouraged education and outreach activities. The SAB should note its concern with the continued erosion of resources in this area and the need for increases. Members saw this area as one where EPA's planning has allowed it to leverage with others well and that modest resource increases could provide larger gains than might be expected otherwise.

Human Health (Dr. Bus):

The human health breakout group noted that this area will undergo a large change because of the recent NRC report on toxicology testing. Even though human exposures to specific chemicals seem to be decreasing, the need to consider multiple chemical exposures at lower levels will create significant demands for interpreting new, more complex scenarios. This change will result in the need for large investments in this type research vs. human epidemiology. It will require EPA collaborations across the Agency and across government as well as a huge training need for Agency personnel needing augmented and changed skill sets. In addition, stability will be needed in the use of extramural grants over time so that these longer term research needs can be successfully addressed.

Technology (Dr. McFarland):

There are three broad issues in the technology area: land preservation, nanotechnology, and Global Earth Observation System of Systems (GEOSS)/ Advanced Monitoring Initiative (AMI). In land preservation, there is a focus on materials management and the Superfund program. The breakout group expressed concern about the loss of funding for the environmental technology verification program and hazardous waste research. Though the breakout group commended the Agency for their use of leveraging to address nanotechnology needs, they did register their concern that the critical issue of mixtures was not being addressed by the Agency for nanotechnology. The group believes that the GEOSS program has tremendous potential, and has been very effective in leveraging limited funds in a number of agencies. It was suggested that it may be more effective to use the limited resources of the GEOSS program to support a few high-end high-profile projects.

Broader Suggestions:

The SAB members noted that they liked the new strategic approach to considering the budget. One SAB member stressed the need for an interdisciplinary research approach, including reaching out to the public and industry to tackle complex problems. Another SAB member cautioned that unfunded projects and future needs must be considered.

Other SAB members made suggestions for Dr. Morgan's testimony. One member suggested that Dr. Morgan display Dr. Teichman's graph of funding in 1999 dollars in his testimony. Another SAB member suggested that Dr. Morgan mention programs that are international, interdisciplinary, and strategic, such as GEOSS. In addition, members suggested that the National Program Director initiative be mentioned in Dr. Morgan's testimony.

The SAB members discussed the regulatory authority of the Agency to perform certain types of environmental research. One SAB member noted that in cases where there is no regulation, research must be done to support regulation. Another SAB member pointed out that the newest, most innovative and celebrated U.S. EPA programs have not been regulatory. Dr. Morgan remarked that the mission of U.S. EPA is to protect human health and the environment, and this objective is not limited to those areas in which the U.S. EPA has regulatory authority. Dr. Teichman agreed that legislative authority exists to do more interdisciplinary research.

<u>Quality Review of the Draft SAB Advisory on the U.S. EPA's Report on the Environment</u>

SAB Discussion:

Dr. Swackhamer introduced the Panel's review of the EPA Report on the Environment. She explained that EPA published a draft Report on the Environment in 2003; however, the report was left in draft form in favor of moving ahead with the next generation of the ROE. That next generation Report on the Environment was once again drafted reflecting a series of major revisions. The SAB panel reviewed the 2007 Report on the Environment and developed the draft report that is before the Panel today (see Attachment K). She noted that the SAB panel developed two groups of recommendations: short-term (i.e., under a year to achieve) and long-term. The recommendations included the following:

- Strengthen scientific underpinnings;
- Develop a conceptual framework;
- Provide statistical analyses and reporting across indicators;
- Address the status and trends for all indicators;
- Provide the criteria used to filter the data;
- Provide additional clarification to differentiate data limitations from data gaps;
- Use geographic units for delineations; and
- Employ additional regional indicators.

Several of the SAB members commented on the panel's draft report (see Attachment L for written comments of the SAB). One SAB member noted that the issue of adjusting criteria was unclear and that the issue should be included in the letter to the Administrator. Another SAB

member noted an issue with the combination of biosolids and mining wastes. One SAB member suggested that the cover letter should reference Council on Environmental Quality (CEQ) publications on the state of the environment. Another SAB member noted that when developing the next Report on the Environment, the SAB should be involved from the beginning.

Dr. Swackhamer noted that her group has prepared written responses to comments and if any SAB members have follow-up questions, they should contact her or Mr. Miller.

Public Comments:

Mr. Miller noted that the SAB had received several public comments submitted on the issue of light pollution (see Attachment M). Several members of the public joined the call and oral comments were offered by Leo Smith, Robert Wagner, and Stephen Davis. They noted that the issue of light pollution has been overlooked by U.S. EPA, but a number of state agencies have recognized it as a serious consequence. The commenters encouraged inclusion of light pollution in the 2007 U.S. EPA Report on the Environment.

Dr. Morgan asked the commenters if they were concerned with light or also radio frequencies. The commenters said that they were concerned with light. They are concerned about ecological effects from light pollution, not astronomical effects. Mr. Wagner elaborated that he was concerned about light pollution in Federal class I areas underneath the Clean Air Act (CAA).

Mr. Stephen Davis remarked that complaints about light pollution started in the early 1900s, around 1910. He suggested that energy, health, commerce, and defense should all be involved in addressing this issue. He suggested that U.S. EPA provide information on this issue, using information distributed by the state of Vermont as an example.

The Board members agreed that a sentence should be added to the air quality section of the draft SAB report on the issue of light pollution

A motion was made to approve the report contingent upon the edits from members being resolved by the Panel Chair. There will be no Vettors for the edits; rather the issue will be left to the Chair to signify that edits are appropriate via his agreement to sign the final report. The motion was passed without dissent.

Adjourn Meeting
Dr. Morgan adjourned the meeting for the day.

Friday, February 29, 2008

Discussion of Draft SAB Report on the U.S. EPA's Strategic Research Directions and Follow Up Activities

Prior to the meeting, Members were asked to comment on the latest draft of the document capturing the October and December 2007 SAB discussions on EPA's strategic research directions. Comments were received and compiled by the DFO and then provided to the

members at this meeting. Dr. Morgan noted that moving to the next draft would take additional work to develop a draft report Members were assigned to topical groups to edit specific portions of the existing Draft SAB Report. A contact person was identified for each subgroup as follows:

- Introductory Material: Dr. Granger Morgan, Dr. Jill Lipoti, Dr. Tom Theis
- Technology: Dr. James Johnson
- Economics and Stability: Dr. James Hammitt and Dr. Thomas Theis
- Ecosystems, Water, and Security Research: Dr. Deborah Swackhamer
- Clean Air and Global Change Research: Dr. Rogene Henderson and Dr. Jerry Schnoor
- Human Health: Dr. James Bus

The SAB reconvened and each subgroup shared editorial suggestions. Mr. Miller will send a Word version of the draft document to members as soon as possible. Members will submit their edits for each section to Mr. Miller by March 20, 2008. Mr. Miller will integrate the comments into the existing document and that will be shared with Members prior to the next SAB meeting during which the Board will again discuss strategic research directions with EPA representatives prior to finalizing this initial advisory report.

The SAB will continue to interact with EPA on its long term research strategy at the next Board meeting (which may be held at a laboratory to allow Members to further discuss specific research projects with ORD scientists). The Board envisions a continuing interaction with ORD at this level over time to, in essence, engage in a dialogue on the strategic research directions. These interactions should allow real-time and continuing input from the SAB into EPA's research planning process and indirectly on the budgets that are proposed each year for conducting research at EPA.

SAB Planning: Strategic Direction Report

Dr. Vu noted that the Strategic Directions Report will be completed during the next SAB meeting. She asked if the SAB members would be interested in meeting with Agency scientists to help them better understand the Agency's in-depth research at the project level. The SAB members agreed that they would be interested in meeting with scientists. In addition to trying to plan our next meeting for an ORD location, the SAB can also arrange for small groups of SAB Members to travel to specific laboratories to conduct discussions with Agency scientists on research program specifics. Discussions could also provide additional insights to the Board on how the EPA research program is planned.

Discussion of SAB Draft Conclusions and Draft Testimony on the FY 2009 Research Budget

Dr. Morgan asked the SAB to discuss the written product generated by the previous day's session. A draft document with the Board's comments from the breakout groups was distributed to all participants. The group agreed that this document would be revised to develop a brief advisory report about the research budget and two versions of testimony (one short and one longer). Dr. Morgan will develop his draft testimony by March 6, 2008. Members will provide additional revisions to the draft advisory document to the DFO by close of business March 5, 2008. Those revisions and Dr. Morgan's draft testimony will be integrated into the draft

advisory report and sent to SAB members for comment on March 6. Member comments on the draft document are due to Mr. Miller by March 12. Mr. Miller will send the revised document to the SAB by March 14 for comments. Any comments on this revised document are due to Mr. Miller by March 18. Completion of the document is targeted for March 21, 2008.

Members were concerned with the overall downward resource trend and wondered at what point the program might reach a tipping point. That is, a point at which EPA will not be able to do the research needed to support its mission. The Agency has to date had success, but expectations for Agency action are growing astronomically. This issue is to be addressed in the introductory section and in the Chair's testimony.

U.S. EPA SAB Planning

Workshop:

Dr. Morgan presented the idea of having the SAB workshop in mid-fall (for additional information about the workshop, see Attachment N. After discussion, the SAB decided that the basic format of the workshop would include one day of presentations by four speakers addressing broad crosscutting issues. The first day would be open to the public and the second day would involve an SAB meeting to consider how to merge the results of day one with the SAB's emerging advice on EPA's strategic research directions. The SAB would attempt to integrate the workshop discussions into the framework of six cross-cutting issues that were identified earlier in this meeting during discussions on EPA's Strategic Research Directions. r. Morgan stated that he and Dr. Nugent would develop a plan for the next steps forward and send the plan to Members in the near future. The DFO will provide and electronic copy of the draft document used in the day one discussions of strategic research directions for members to use in considering who else might be a candidate to present at the workshop and for potential presenters to consider how to frame their presentations to reflect the six themes. Consideration of an evening celebration event was not conclusive.

SAB Planning: Environmental Disasters

Dr. Morgan noted that the SAB will need to revise the Environmental Disasters Report pending comments on the draft (comments from the SAB are available in Attachment O). Dr. Morgan said that the SAB will try to have a final version of the report for the next SAB meeting (tentatively scheduled for May 2008). Member comments will be requested prior to the meeting and those comments, along with the Agency reactions, will be used to mark up the draft, and they will serve as the basis for the SAB's continued discussion at that meeting.

Adjourn the Meeting

The Designated Federal Officer adjourned the meeting.

Action Items:

- Dr. Thompson will send a revised final draft of the SAB Valuing the Protection of Ecological Systems and Services Report to the SAB in May 2008.
- The U.S. EPA Report on the Environment is approved subject to requested revisions.
- Revisions to the Draft SAB Report on the U.S. EPA's Strategic Research Directions must be submitted to Mr. Miller in redline strikeout by March 20, 2008.
- All SAB member comments on the draft SAB FY 2009 Research Budget document are due to Mr. Miller and Dr. Vu by March 5, 2008.
- Mr. Miller will send the revised SAB FY 2009 Research Budget document to the SAB by March 12, 2008 for comments.
- A second round of comments on the revised SAB FY 2009 Research Budget document are due to Mr. Miller by March 17, 2008.
- The next SAB meeting is tentatively scheduled for May 12 and 13, 2008.

Respectfully Submitted:

/ Signed /

Mr. Thomas Miller
SAB DFO

Certified as True:

/ Signed /

Dr. Granger Morgan
SAB Chair

ATTACHMENTS

Attachment A: List of SAB Board Members
Attachment B: Meeting Agenda
Attachment C: *Federal Register* announcement of the meeting
Attachment D: List of Meeting Attendees
Attachment E: Dr. Koizumi's Presentation
Attachment F: Mr. Bloom's Presentation
Attachment G: Dr. Teichman's Presentation
Attachment H: Team Assignments for Breakout Groups
Attachment I: Overview and Update on the SAB Project on Valuing the Protection of Ecological Systems and Services PowerPoint Presentation
Attachment J: Breakout Group Comment's on FY 2009 Budget
Attachment K: Draft SAB Panel Advisory on the EPA 2007 Report on the Environment.
Attachment L: Compilation of Comments on SAB Panel Review of the U.S. EPA's report on the Environment
Attachment M: Public Comments
Attachment N: Draft Workshop Information
Attachment O: Comments on Environmental Disaster Report

Attachment A

U.S. Environmental Protection Agency
Science Advisory Board
BOARD

CHAIR

Dr. M. Granger Morgan, Lord Chair Professor in Engineering, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA

SAB MEMBERS

Dr. Thomas Burke, Professor, Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD

Dr. James Bus, Director of External Technology, Toxicology and Environmental Research and Consulting, The Dow Chemical Company, Midland, MI

Dr. Deborah Cory-Slechta, Professor, Department of Environmental Medicine, School of Medicine and Dentistry, University of Rochester, Rochester, NY

Dr. Virginia Dale, Corporate Fellow, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Dr. Kenneth Dickson, Regents Professor, Department of Biological Sciences, University of North Texas, Aubrey, TX

Dr. David A. Dzombak, Walter J. Blenko Sr. Professor of Environmental Engineering, Department of Civil and Environmental Engineering, College of Engineering, Carnegie Mellon University, Pittsburgh, PA

Dr. James K. Hammitt, Professor, Center for Risk Analysis, Harvard University, Boston, MA

Dr. Rogene Henderson, Senior Scientist Emeritus, Lovelace Respiratory Research Institute, Albuquerque, NM

Dr. James H. Johnson, Professor and Dean, College of Engineering, Architecture & Computer Sciences, Howard University, Washington, DC

Dr. Bernd Kahn, Director, Environmental Radiation Center, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA

Dr. Agnes Kane, Professor and Chair, Department of Pathology and Laboratory Medicine, Brown University, Providence, RI

Dr. George Lambert, Associate Professor of Pediatrics, Director, Center for Childhood Neurotoxicology, Robert Wood Johnson Medical School-UMDNJ, Belle Mead, NJ

Dr. Jill Lipoti, Director, Division of Environmental Safety and Health, New Jersey Department of Environmental Protection, Trenton, NJ

Dr. Michael J. McFarland, Associate Professor, Department of Civil and Environmental Engineering, Utah State University, Logan, UT

Dr. Judith L. Meyer, Distinguished Research Professor Emeritus, Institute of Ecology, University of Georgia, , Athens, GA

Dr. Rebecca Parkin, Professor and Associate Dean, Environmental and Occupational Health, School of Public Health and Health Services, The George Washington University Medical Center, Washington, DC

Dr. Stephen M. Roberts, Professor, Department of Physiological Sciences, Director, Center for Environmental and Human Toxicology, University of Florida, Gainesville, FL

Dr. Joan B. Rose, Professor and Homer Nowlin Chair for Water Research, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI

Dr. James Sanders, Director and Professor, Skidaway Institute of Oceanography, Savannah, GA

Dr. Jerald Schnoor, Allen S. Henry Chair Professor, Department of Civil and Environmental Engineering, Co-Director, Center for Global and Regional Environmental Research, University of Iowa, Iowa City

Dr. Kathleen Segerson, Professor, Department of Economics, University of Connecticut, Monteith Bldg, Storrs, CT

Dr. Kristin Shrader-Frechette, O'Neil Professor of Philosophy, Department of Biological Sciences and Philosophy Department, University of Notre Dame, Notre Dame, IN

Dr. Deborah Swackhamer, Interim Director and Professor, Institute on the Environment, University of Minnesota, St. Paul, MN

Dr. Thomas L. Theis, Director, Institute for Environmental Science and Policy, University of Illinois at Chicago, Chicago, IL

Dr. Valerie Thomas, Anderson Interface Associate Professor, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA

Dr. Barton H. (Buzz) Thompson, Jr., Robert E. Paradise Professor of Natural Resources Law at the Stanford Law School and Director, Woods Institute for the Environment Director, Stanford University, Stanford, CA

Dr. Lauren Zeise, Chief, Reproductive and Cancer Hazard Assessment Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Oakland, CA

LIAISONS

Dr. Steven Heeringa, (Chair, FIFRA SAP), Research Scientist and Director, Statistical Design Group, Institute for Social Research (ISR), University of Michigan, Ann Arbor, MI

Dr. Henry Anderson, (CHPAC Alternate), Chief Medical Officer, Division of Public Health, Wisconsin Division of Public Health, Madison, WI

SCIENCE ADVISORY BOARD STAFF

Mr. Thomas Miller, Designated Federal Officer, 1200 Pennsylvania Avenue, NW 1400F, Washington, DC, 20460, Phone: 202-343-9982, Fax: 202-233-0643, (miller.tom@epa.gov)

Attachment B
U.S. Environmental Protection Agency
Science Advisory Board
Meeting Agenda

Westin Arlington Gateway
801 N. Glebe Road
Arlington, VA 22203
703.717.6200
February 28-29, 2008

Purpose of the Meeting: The Board will meet to discuss EPA's research budget for FY 2009 and to review a Draft SAB Panel report and conduct other business as time permits.

Thursday February 28, 2008

8:30 a.m.	**Convene the Meeting**	**Thomas O. Miller** *Designated Federal Officer, EPA SAB*
	Welcome	**Dr. Vanessa Vu** *Director, EPA SAB Staff Office*
8:45 a.m.	**Introduction of SAB Members**	**Dr. M. Granger Morgan** *Chair* *EPA Science Advisory Board*
	Meeting Purpose and Approach	
9:00 a.m.	**Overview of Federal Research Budgets for FY 2009**	**Dr. Kei Koizumi** *R&D Budget and Policy Program* *American Association for the Advancement of Science*
9:45 a.m.	**Overview of the EPA FY 2009 Budget**	**Mr. David Bloom** *Director* *Office of Budget* *EPA/OCFO*
		Ms. Laura Palmer *Acting Staff Director* *Mlultimedia Analysis Staff* *EPA/OCFO* *Office of Budget*

10:00 a.m.	**Question and Answer Session for EPA OCFO**	**SAB Members** **Mr. David Bloom** **Ms. Laura Palmer**
10:15 a.m.	**Break**	
10:30 a.m.	**Overview of the EPA FY 2009 Research Budget** **Questions and Answer Session on the FY 2009 Research Budget**	**Dr. Kevin Teichman** *Deputy Assistant Administrator for Science EPA Office of Research and Development*
11:00 a.m.	**General Discussion of EPA Research Budget Priorities**	**SAB Members** **ORD Representatives** **Regional and Program Office Representatives**
11:40 a.m.	**Concurrent Breakout Sessions to Discuss FY 2009 Research Budgets for Specific Research Programs** (See Attachment A below)	**SAB Members** **ORD Representatives** **Regional and Program Office Representatives**
12:15 p.m.	**Lunch**	
12:55 p.m.	**Overview and Update of the SAB Project on Valuing the Protection of Ecological Systems and Services**	**Dr. Barton Thompson** *Chair* *SAB/CVPESS* **Dr. Kathleen Segerson,** *Vice Chair* *SAB/CVPESS*
1:15 p.m.	**Continue Concurrent Breakout Sessions to Discuss FY 2009 Research Budgets for Specific Research Programs** (See Attachment A below):	**SAB Members** **ORD Representatives** **Regional and Program Office Representatives**
3:15 p.m.	**Break**	
3:30 p.m.	**Report Out from Break Out Sessions**	**SAB Members**
4:30 p.m.	**Quality Review of the Draft SAB Advisory on EPA's Report on the Environment** **a) SAB Discussion** **b) Public Comments (2)**	**SAB Members**
5:15 p.m.	**Action Items and Adjourn for the Day**	

Friday, February 29, 2008

8:30 a.m.	**Reconvene the Meeting**	**Thomas O. Miller DFO**
8:35 a.m.	**Discussion of Draft SAB Report on EPA's Strategic Research Directions and Follow-up Activities**	**SAB Members**
9:30 a.m.	**Discussion of SAB Draft Conclusions on the FY 2009 Research Budget**	**SAB Members**
10:45 a.m.	**Break**	
11:00 a.m.	**Discussion of SAB Draft Testimony on the FY 2009 Research Budget**	**SAB Members**
12:00 p.m.	**SAB Planning:**	
	o **Workshop**	**Dr. M. Granger Morgan** *Chair* *EPA Science Advisory Board* **Dr. Angela Nugent** *SAB Staff Office* **SAB Members**
	o **Other**	
	▪ **Environmental Disasters; Action Items**	**Dr. M. Granger Morgan** **SAB Members**
1:00 pm	**Adjourn the Meeting**	**The DFO**

ATTACHMENT A
Break Out Groups and Tentative Participants

Break Out Group	EPA ORD Representatives	SAB Members*
Human Health Break Out Group: (Note this area contains some ecosystems research) - **Human Health** - **Computational Toxicology** - **Endocrine Disruptors** - **Safe Pesticides/Safe Products** - **Human Health Risk Assessment**	**Dr. Sally Darney** *ORD Acting NPD for Human Health Research* **Dr. Jerry Blancato** *Deputy Director, EPA ORD National Center for Computational Toxicology* **Dr. Elaine Francis** *ORD NPD for Pesticides and Toxics Research* **Dr. Elaine Francis** **Dr. John Vandenberg** *Associate Director EPA ORD National Center for Environmental Assessment*	Dr. James Bus Dr. Thomas Burke Dr. Deborah Cory-Slechta Dr. Steve Heeringa Dr. Agnes Kane Dr. George Lambert Dr. Steve Roberts Dr. Kristin Shrader-Frechette Dr. Lauren Zeise DFO: Dr. Suhair Shallal
Ecosystems, Water and Security Research: - **Drinking Water** - **Homeland Security** - **Ecological Research** - **Water Quality**	**Dr. Audrey Levine** *ORD NPD for Drinking Water Research* **Dr. Jon Herrmann** *Director, EPA National Homeland Security Research Center* **Dr. Rick Linthurst** *ORD NPD for Ecological Protection Research* **Dr. Chuck Noss** *ORD NPD for Water Quality Research*	Dr. Virginia Dale Dr. Kenneth Dickson Dr. Judith Meyer Dr. Joan Rose Dr. James Sanders Dr. Deborah Swackhamer Dr. Buzz Thompson DFO: Dr. Thomas Armitage

<u>Economics and Sustainability:</u> - **Economics and Decision Sciences** - **Sustainability**	**Dr. Al McGartland** *Director, EPA National Center for Environmental Economics* **Dr. Alan Hecht** *ORD, Director of Sustainability*	Dr. James Hammitt Dr. Rebecca Parkin Mr. David Rejeski Dr. Kathy Segerson Dr. Thomas Theis DFO: Dr. Holly Stallworth
<u>Clean Air and Global Change Research:</u> - **Global Change** - **Clean Air (formerly NAAQS and Air Toxics)**	**Dr. Mike Slimak** *Associate Director for Ecology, ORD National Environmental Research Center* **Dr. Dan Costa** *ORD NPD for Air Research*	Dr. Rogene Henderson Dr. Jill Lipoti Dr. Granger Morgan Dr. Jerald Schnoor DFO: Mr. Fred Butterfield
<u>Technology</u> - **Land Preservation** - **Nanotechnology** - **GEOSS/AMI**	**Dr. Randy Wentsel** *ORD NPD for Contaminated Sites and Resource Conservation Research* **Dr. Nora Savage** *Nanotechnology Project Leader* **Mr. Ed Washburn** *Co-Chair of EPA GEOSS Coordinating Committee*	Dr. David Dzombak Dr. James Johnson Dr. Bernd Kahn Dr. Mike McFarland Dr. Valerie Thomas DFO: Ms. Kathleen White

ENVIRONMENTAL PROTECTION AGENCY

[FRL–8523–1]

Science Advisory Board Staff Office; Notification of a Meeting of the Science Advisory Board

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: The EPA Science Advisory Board (SAB) Staff Office announces a public face-to-face meeting of the chartered SAB to: (1) Discuss EPA's research budget for Fiscal Year 2009; (2) Agency long-term research directions and priorities; (3) conduct a quality review of the Draft *SAB Advisory on EPA's ''Report on the Environment 2007: Science Report''*; and (4) continue planning for upcoming SAB meetings.

DATES: The meeting dates are Thursday, February 28, 2008, from 8:30 a.m. to 5:30 p.m. through Friday, February 29, 2008, from 8:30 a.m. to 2:00 p.m. (Eastern Time).

ADDRESSES: The meeting will be held at the Westin Arlington Gateway, 801 N. Glebe Road, Arlington, VA 22203; phone (703) 717–6200.

FOR FURTHER INFORMATION CONTACT: Members of the public who wish to obtain further information about this meeting may contact Mr. Thomas O. Miller, Designated Federal Officer (DFO), by mail at EPA SAB Staff Office, (1400F), U.S. EPA, 1200 Pennsylvania Avenue, NW., Washington, DC 20460; by telephone at (202) 343–9982; by fax at (202) 233–0643; or by e-mail at: *miller.tom@epa.gov*. General information about the SAB, as well as any updates concerning the meeting announced in this notice, may be found on the SAB Web Site at: *http://www.epa.gov/sab*.

SUPPLEMENTARY INFORMATION: The SAB was established by 42 U.S.C. 4365 to provide independent scientific and technical advice, consultation, and recommendations to the EPA Administrator on the technical basis for Agency positions and regulations. The SAB is a Federal advisory committee chartered under the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App. The SAB will comply with the provisions of FACA and all appropriate SAB Staff Office procedural policies.

Background: The purpose of this meeting will be to allow the SAB to discuss with Agency representatives the research priorities that are a component of the Fiscal Year 2009 research budget. The SAB conducts a review of the EPA research budget each year and as a result of discussions and evaluations that are a part of this review, provides written advice to the EPA Administrator and testimony to the U.S. Congress on how that budget might contribute to the achievement of EPA's overall research goals.

The SAB will also conduct a quality review of one draft SAB Committee report, *SAB Advisory on EPA's ''Report on the Environment 2007: Science Report.''* The EPA Report on the Environment (ROE) 2007 addresses key questions about the current status of and trends in the condition of the environment and human health. These questions are intended to be relevant to EPA's current regulatory and programmatic activities and mission. In its review, the SAB was asked to comment on: (1) The adequacy of the formulation and scope of the questions addressed in the ROE 2007 Science Report, (2) the appropriateness of the indicators used to answer the questions in the report, (3) the accuracy of the characterization of gaps and limitations in the indicators used in the report, (4) the appropriateness of regionalization of national indicators in the report, (5) the utility of regional indicators in the report, and (6) the overall quality of the report with respect to technical accuracy, clarity, and appropriateness of level of communication. Additional information on this review can be found in the announcement of the review in the **Federal Register** (see FR 72 29498–29499 of May 29, 2007) and the EPA SAB Web Site at: *http://yosemite.epa.gov/sab/sabproduct.nsf/02ad90b136fc21ef85256eba00436459/2457aac81d2003a98525701900616b47!OpenDocument*.

Availability of Meeting Materials: Materials in support of this meeting will be placed on the SAB Web Site at: *http://www.epa.gov/sab* in advance of this meeting.

Procedures for Providing Public Input: Interested members of the public may submit relevant written or oral information for the SAB to consider on the topics included in this advisory activity and/or the group conducting the activity.

Oral Statements: In general, individuals or groups requesting an oral presentation at a public meeting will be limited to five minutes per speaker, with no more than one hour for all speakers. Interested parties should contact Mr. Miller, DFO, at the contact information provided above, by February 21, 2008, to be placed on the public speaker list for the February 28–29, 2008 meeting. *Written Statements:* Written statements should be received in the SAB Staff Office by February 14, 2008, so that the information may be made available to the SAB for their consideration prior to this meeting. Written statements should be supplied to the DFO via e-mail to *miller.tom@epa.gov* (acceptable file format: Adobe Acrobat PDF, WordPerfect, MS Word, MS PowerPoint, or Rich Text files in IBM–PC/Windows 98/2000/XP format).

Accessibility: For information on access or services for individuals with disabilities, please contact Mr. Thomas Miller at (202) 343–9982, or via e-mail at *miller.tom@epa.gov*. To request accommodation of a disability, please contact Mr. Miller, preferably at least 10 days prior to the meeting, to give EPA as much time as possible to process your request.

Dated: January 24, 2008.

Anthony Maciorowski,

Deputy Director, EPA Science Advisory Board Staff Office.

[FR Doc. E8–1793 Filed 1–30–08; 8:45 am]

BILLING CODE 6560–50–P

ENVIRONMENTAL PROTECTION AGENCY

[FRL–8523–3]

Science Advisory Board Staff Office; Request for Nominations for Science Advisory Board Panel on Risk and Technology Review Assessments for Phase II Source Categories

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: The EPA Science Advisory Board (SAB) Staff Office is announcing the formation of an SAB Expert panel to review and provide advice about draft risk assessments that evaluate the effects of industrial emissions of hazardous air pollutants (HAPs) on public health and the environment in accordance with EPA's Risk and Technology Review (RTR) Assessment. The SAB Staff Office is soliciting public nominations of technical experts for this panel.

DATES: Nominations should be submitted by February 21, 2008 per the instructions below.

FOR FURTHER INFORMATION CONTACT: Members of the public who wish to obtain further information regarding the submission of nominations may contact Dr. Resha M. Putzrath, via telephone at: (202) 343–9978 or e-mail at: *putzrath.resha@epa.gov*. The SAB Mailing address is: U.S. EPA Science Advisory Board (1400F), U.S. Environmental Protection Agency, 1200

Pennsylvania Avenue, NW., Washington, DC 20460. General information about the SAB as well as any updates concerning this request for nominations may be found on the SAB Web site at: *http://www.epa.gov/sab*.

Technical Contact: For questions and information concerning the Agency's draft technical documents and background information, contact Dr. Dave Guinnup, at: (919) 541–5368, or *guinnup.dave@epa.gov*.

SUPPLEMENTARY INFORMATION:

Background: The SAB was established by 42 U.S.C. 4365 to provide independent scientific and technical advice to the Administrator on the technical basis for Agency positions and regulations. The SAB is a Federal Advisory Committee chartered under the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App. The SAB will comply with the provisions of FACA and all appropriate SAB Staff Office procedural policies.

Section 112(f)(2)(A) of the 1990 Clean Air Act Amendments (CAA) requires EPA to evaluate whether emission standards that were previously adopted under the technology-based, Maximum Achievable Control Technology (MACT) program provide an ample margin of safety to protect public health and prevent adverse environmental effects (taking into consideration costs, energy, safety, and other relevant factors). Within eight years of the promulgation of a MACT standard for the source category, EPA is mandated by the CAA to assess the risks to determine whether additional standards are needed.

EPA's Office of Air and Radiation has developed a Risk and Technology Review (RTR) Assessment Plan (referred to as RTR II) that has a streamlined approach. The SAB provided advice in a consultation on the RTR II in December 2006 [Consultation on EPA's Risk and Technology Review (RTR) Assessment Plan (EPA–SAB–07–009) available at: *http://yosemite.epa.gov/sab/sabproduct.nsf/33152C83D29530F08525730D006C3ABF/$File/sab-07-009.pdf*]. The SAB identified some key scientific issues and provided recommendations for the Plan. The SAB Panel being formed will review EPA's draft risk assessments developed under the RTR II approach, as modified to reflect SAB recommendations. These draft risk assessments will evaluate the potential risks to human health and the environment that remain after sources come into compliance with MACT.

Request for Nominations: The SAB Staff Office is requesting nominations for nationally and internationally recognized, non-EPA scientists with expertise and experience related to: Airborne (and possibly multi-pathway) fate-and-transport modeling of organic and inorganic chemicals; modeling of potential human exposures; modeling of human health risk; health effects of individual chemicals and mixtures of chemicals; risk assessment models and practices; uncertainty or sensitivity analyses; and risk communication theory and practice. The Agency is particularly interested in nominees with in-depth knowledge and experience in evaluating effects, exposure, and risk of hazardous air pollutants.

Process and Deadline for Submitting Nominations: Any interested person or organization may nominate qualified individuals with expertise and experience described above for consideration of service on the SAB Panel on Risk and Technology Review Assessments for Phase II Source Categories. Nominations should be submitted in electronic format through the SAB Web site at the following URL: *http://yosemite.epa.gov/sab/sabproduct.nsf/Web/participatepanelformation?OpenDocument*. Please follow the instructions for submitting nominations carefully. To be considered, nominations should include all of the information required on the associated forms. Anyone unable to submit nominations using the electronic form or who has any questions concerning the nomination process may contact Dr. Resha M. Putzrath, as indicated above in this notice. Nominations should be submitted in time to arrive no later than February 21, 2008.

To be considered, all nominations should include: A current *curriculum vitae* (C.V.) which provides the nominee's background, qualifications, research expertise, and relevant publications for service on the Panel; and a brief biographical sketch (''biosketch''). The biosketch should be no longer than one page and should contain the following information for the nominee: (a) Current professional affiliations and positions held; (b) area(s) of expertise, and research activities and interests relevant to the Panel; (c) leadership positions in national associations or professional publications or other significant distinctions; (d) educational background, especially advanced degrees, including when and from which institutions these were granted; and (e) service on other advisory committees or professional societies, especially those associated with issues under discussion in this review. Incomplete biosketches will not be considered. The EPA SAB Staff Office will acknowledge receipt of nominations.

The names and biosketches of qualified nominees identified by respondents to the **Federal Register** notice and additional experts identified by the SAB Staff will be posted on the SAB Web site accessible through a link for this panel at: *http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/CommitteesandMembership?OpenDocument*. Public comments on this ''Short List'' of candidates will be accepted for 21 calendar days. The public will be requested to provide relevant information or other documentation on nominees that the SAB Staff Office should consider in evaluating candidates.

For the EPA SAB Staff Office, a balanced subcommittee or review panel includes candidates who possess the necessary domains of knowledge, the relevant scientific perspectives (which, among other factors, can be influenced by work history and affiliation), and the collective breadth of experience to adequately address the charge. To establish individual expert panels for the advisory activities described above, the SAB Staff Office will consider public comments on the ''Short List'' of candidates, information provided by the candidates themselves, and background information independently gathered by the SAB Staff Office. Specific criteria to be used for Panel membership include: (a) Scientific and/or technical expertise, knowledge, and experience (primary factors); (b) availability and willingness to serve; (c) absence of financial conflicts of interest; (d) absence of an appearance of a lack of impartiality; and (e) skills working in committees, subcommittees, and advisory panels; and (f) for the Panel as a whole, diversity of, and balance among, factors such as scientific expertise and viewpoints.

The SAB Staff Office's evaluation of an absence of financial conflicts of interest will include a review of the ''Confidential Financial Disclosure Form for Special Government Employees Serving on Federal Advisory Committees at the U.S. Environmental Protection Agency'' (EPA Form 3110–48). This confidential form allows Government officials to determine whether there is a statutory conflict between that person's public responsibilities (which includes membership on an EPA Federal advisory committee) and private interests and activities, or the appearance of a lack of impartiality, as defined by Federal regulation. The form

may be viewed and downloaded from the following URL address: *http://yosemite.epa.gov/sab/sabproduct.nsf/WebSABSO/ethics?OpenDocument*.

The approved policy under which the EPA SAB Office selects subcommittees and review panels is described in the following document: Overview of the Panel Formation Process at the Environmental Protection Agency Science Advisory Board (EPA–SAB–EC–02–010), which is posted on the SAB Web site at: *http://yosemite.epa.gov/sab/sabproduct.nsf/WebSABSO/OverviewPanelForm?OpenDocument*.

Dated: January 24, 2008.

Anthony F. Maciorowski,

Deputy Director, EPA Science Advisory Board Staff Office.

[FR Doc. E8–1772 Filed 1–30–08; 8:45 am]

BILLING CODE 6560–50–P

ENVIRONMENTAL PROTECTION AGENCY

[FRL–8522–9]

Science Advisory Board Staff Office, SAB Particulate Matter (PM) Research Centers Program Review Panel; Request for Nominations

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: The U.S. Environmental Protection Agency (EPA or Agency) Science Advisory Board (SAB) Staff Office is announcing the formation of an SAB panel to advise the Agency concerning the future direction of its Particulate Matter (PM) Research Centers Program. The SAB Staff Office is soliciting public nominations for this Panel.

DATES: New nominations should be submitted by February 21, 2008.

FOR FURTHER INFORMATION CONTACT: Any member of the public wishing further information regarding this Request for Nominations may contact Mr. Fred Butterfield, Designated Federal Officer (DFO), EPA Science Advisory Board (1400F), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW., Washington, DC 20460; via telephone/voice mail: (202) 343–9994; fax: (202) 233–0643; or e-mail at: *butterfield.fred@epa.gov*. General information concerning the EPA Science Advisory Board can be found on the EPA Web Site: *http://www.epa.gov/sab.*

SUPPLEMENTARY INFORMATION:

Background: The SAB was established by 42 U.S.C. 4365 to provide independent scientific and technical advice to the Administrator on the technical basis for Agency positions and regulations. The SAB is a Federal advisory Committee chartered under the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App. The SAB will comply with the provisions of FACA and all appropriate SAB Staff Office procedural policies.

In EPA's 1998 appropriations bill, Congress directed EPA to establish as many as five university-based particulate matter (PM) research centers as part of the expanded Office of Research and Development (ORD) PM research program. The first research centers were funded from 1999 to 2005. The total budget for each center over five years was $8 million, for a program total of $40 million. In the original Request for Applications (RFA), prospective Centers were asked to propose an integrated research program on the health effects of PM, including exposure, dosimetry, toxicology and epidemiology. In 2004, a second competition was held. This RFA asked respondents to address the central theme of ''linking health effects to PM sources and components,'' and to focus on the research priorities of susceptibility, biological mechanisms, exposure-response relationships, and source linkages. From the second competition, five current centers are funded for 2005–2010 (the budget remains $40 million total).

ORD's PM Research Centers program was initially shaped by recommendations from the National Research Council. The SAB conducted an interim review of the Centers program in 2002 (see: *http://yosemite.epa.gov/sab/sabproduct.nsf/6374FD2B32EFE730852570CA007415FE/$File/ec02008.pdf)*, which was instrumental in providing additional guidance for the second phase of the program (2005–2010). The Agency now seeks the advice of an SAB expert panel on the structure and strategic direction for the program as ORD contemplates funding a third round of air pollution research centers into the future. This Federal Register notice solicitation is seeking nominations for the SAB PM Research Centers Program Review Panel.

Request for Nominations: The SAB Staff Office is requesting nominations for nationally- and internationally-recognized, non-EPA scientists with extensive research program management expertise and experience related to airborne pollution and the application of research results in reducing air pollution in protection human health and the environment. The experts should also have had direct research experience related to PM.

Process and Deadline for Submitting Nominations: Any interested person or organization may nominate qualified individuals to add expertise to the SAB PM Research Centers Program Review Panel in the areas of expertise listed above. Nominations should be submitted in electronic format through the SAB Web site: *http://yosemite.epa.gov/sab/sabproduct.nsf/Web/participatepanelformation?OpenDocument.* Please follow the instructions for submitting nominations carefully. To be considered, nominations should include all of the information required on the associated forms. Anyone unable to submit nominations using the electronic form and who has any questions concerning the nomination process may contact Mr. Fred Butterfield, DFO, as indicated above in this notice. Nominations should be submitted in time to arrive no later than February 21, 2008.

To be considered, all nominations should include: A current curriculum vitae (C.V.) which provides the nominee's background, qualifications, research expertise and relevant publications for service on the Panel; and a brief biographical sketch (''biosketch''). The biosketch should be no longer than one page and should contain the following information for the nominee:

(a) Current professional affiliations and positions held;

(b) Area(s) of expertise, and research activities and interests relevant to the Panel;

(c) Leadership positions in national associations or professional publications or other significant distinctions;

(d) Educational background, especially advanced degrees, including when and from which institutions these were granted; and

(e) Service on other advisory committees or professional societies, especially those associated with issues under discussion in this review.

Incomplete biosketches will not be considered. The EPA SAB Staff Office will acknowledge receipt of nominations.

The EPA SAB Staff Office will post the biosketches of qualified nominees for public comment on the SAB Web site. Information will be made available via the link to this panel found at: *http://yosemite.epa.gov/sab/sabproduct.nsf/WebBoard/SABAdHocCommitteesandPanels?OpenDocument,* and will include, for each candidate, the nominee's name and their biosketch. Public comments on this ''Short List'' of candidates will be accepted for 21 calendar days. The

Environmental R&D in the 2009 Budget

Kei Koizumi

February 28, 2008

for the EPA Science Advisory Board

AAAS R&D Budget and Policy Program

http://www.aaas.org/spp/rd

See the “What’s New” section for the latest updates; see the “Seminars and Presentations” section for copies of this presentation.

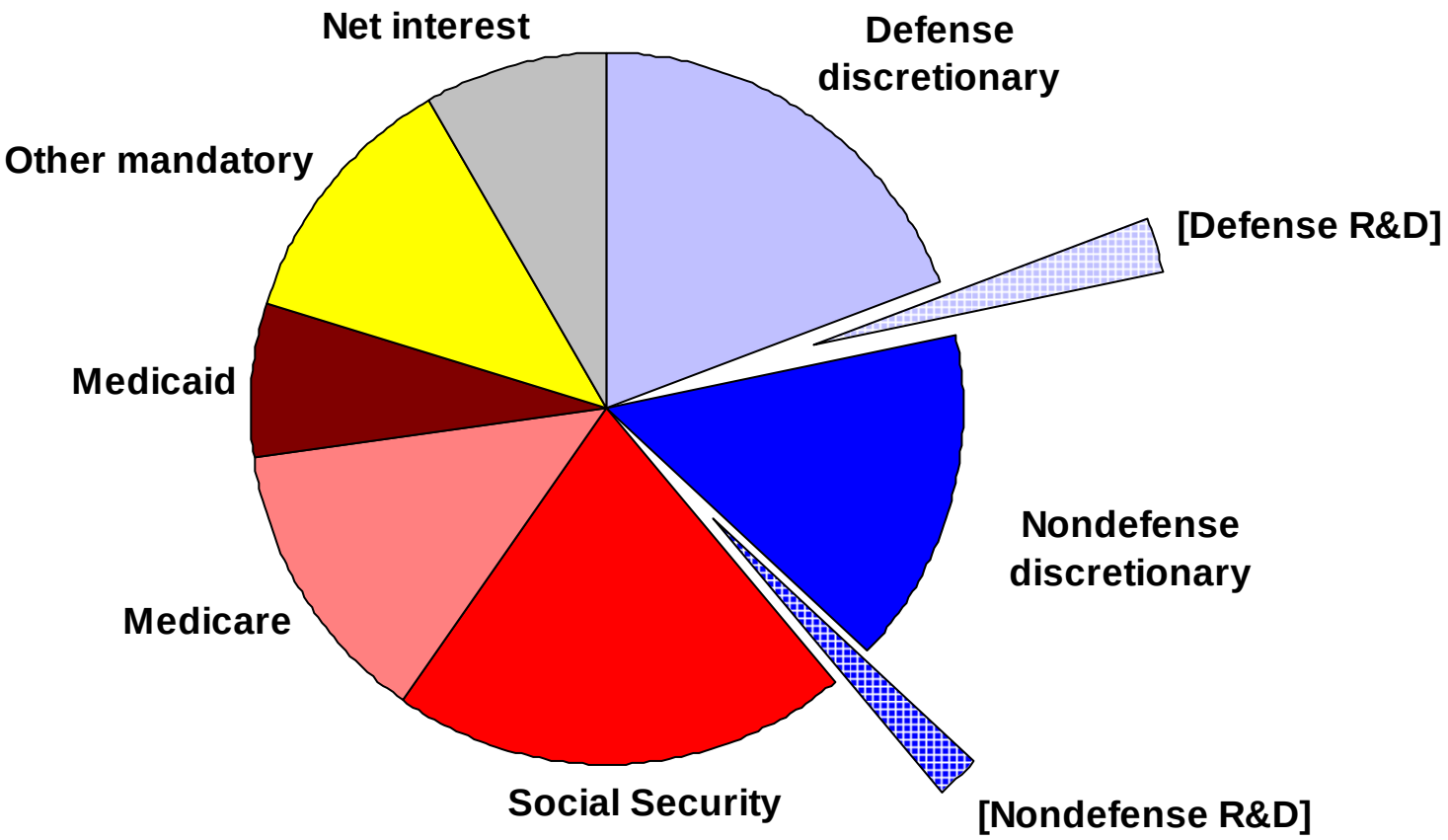
AAAS

ADVANCING SCIENCE, SERVING SOCIETY

THE 2009 BUDGET

- The President has proposed a $3.1 trillion budget for FY 2009.
- The budget deficit could approach a record $500 billion this year and next year.
- To help control the deficit, the President proposes to keep domestic appropriations flat, and leaves war funding out of the budget beyond January 2009.
- Domestic spending in real terms has been flat since 2004, and would fall through 2013.

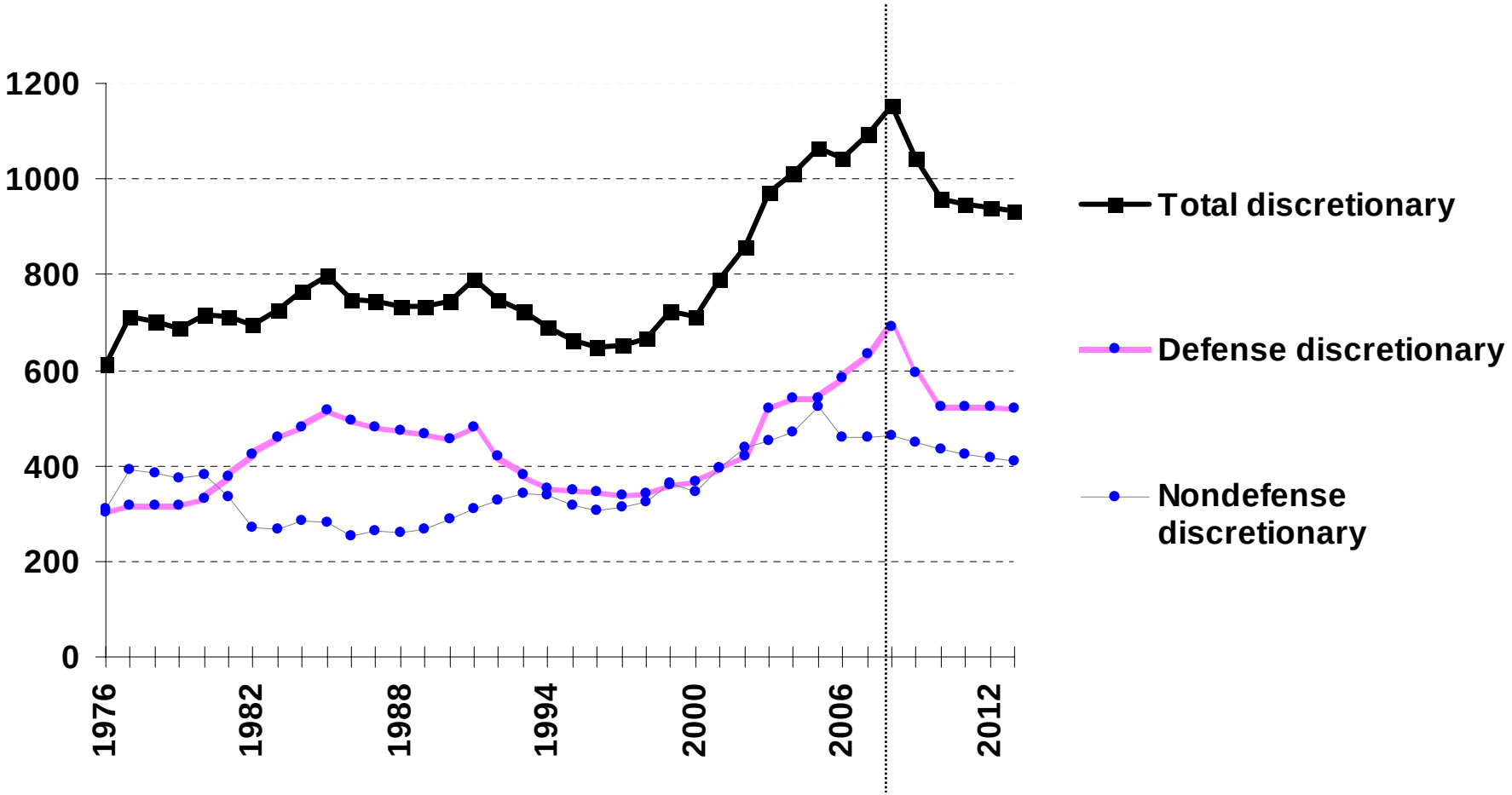
Composition of the Proposed FY 2009 Budget
Total Outlays = $3.1 trillion



Note: Projected Unified deficit is $407 billion.
Figures exclude most Iraq and Afghanistan military costs.
Source: AAAS, based on *Budget of the United States Government FY 2009.*

Trends in Discretionary Spending, FY 1976-2013

in billions of constant FY 2008 dollars



Data in fiscal years. Source: *Budget of the United States Government, FY 2009.*
FY 2008 data are estimates. FY 2009-2013 data are budget projections. FY 2009-2013 figures exclude Iraq and Afghanistan military costs.

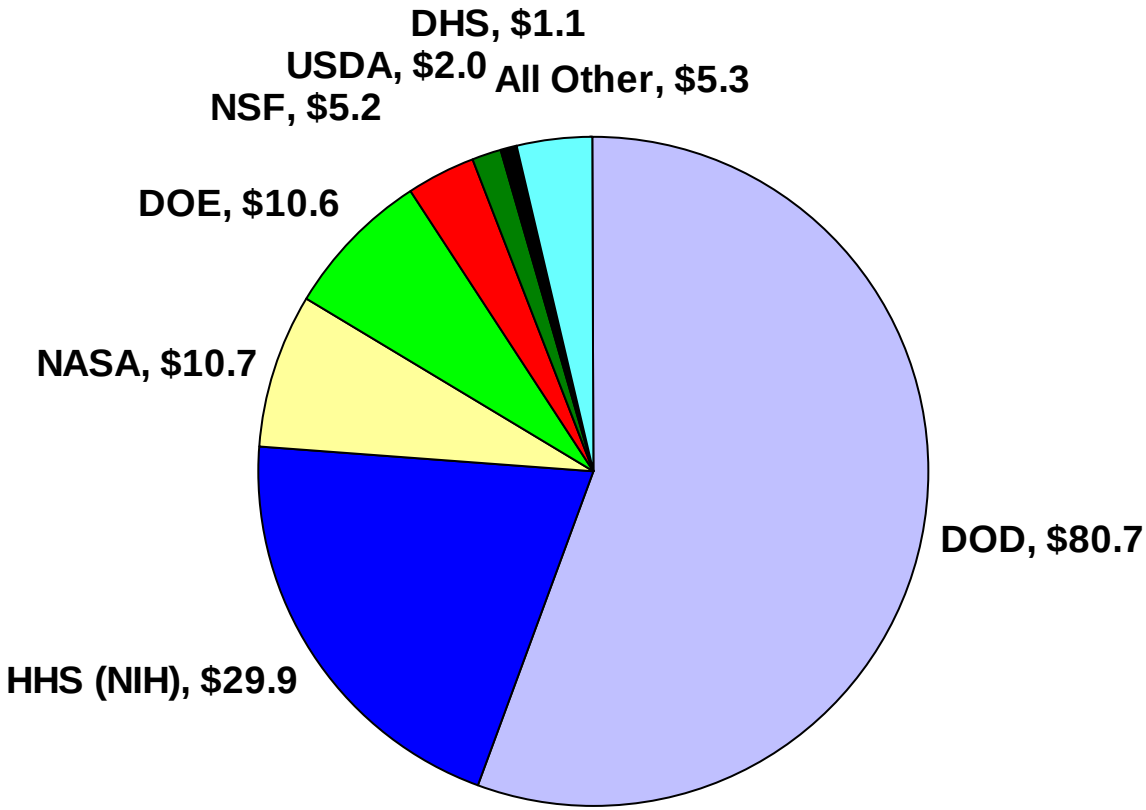
AAAS

THE 2009 BUDGET FOR R&D

- The American Competitiveness Initiative (ACI) continues for a third year, with large increases for basic physical sciences research in NSF, DOE Science, and the NIST labs to catch up to a 10-year doubling track.
- Again, there would be large increases for DOD weapons and NASA spacecraft development, but also increases for most R&D programs.
- But the NIH budget would be flat, and R&D in agricultural and environmental agencies would fall.

Total R&D by Agency: FY 2009 Proposed

Budget Authority in billions of dollars

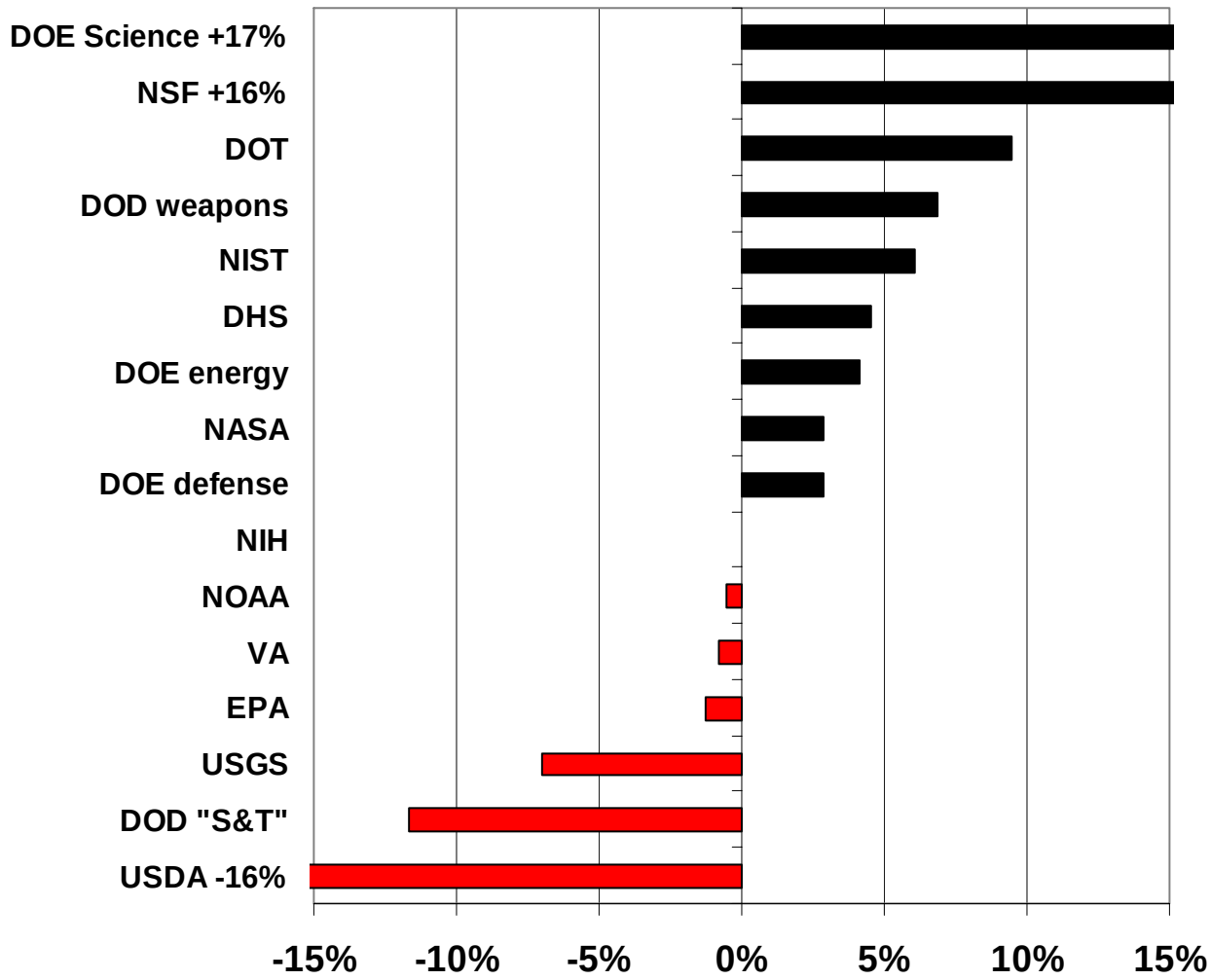


Total R&D = $145.4 billion (preliminary)

Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2009.

FY 2009 R&D Request (preliminary)

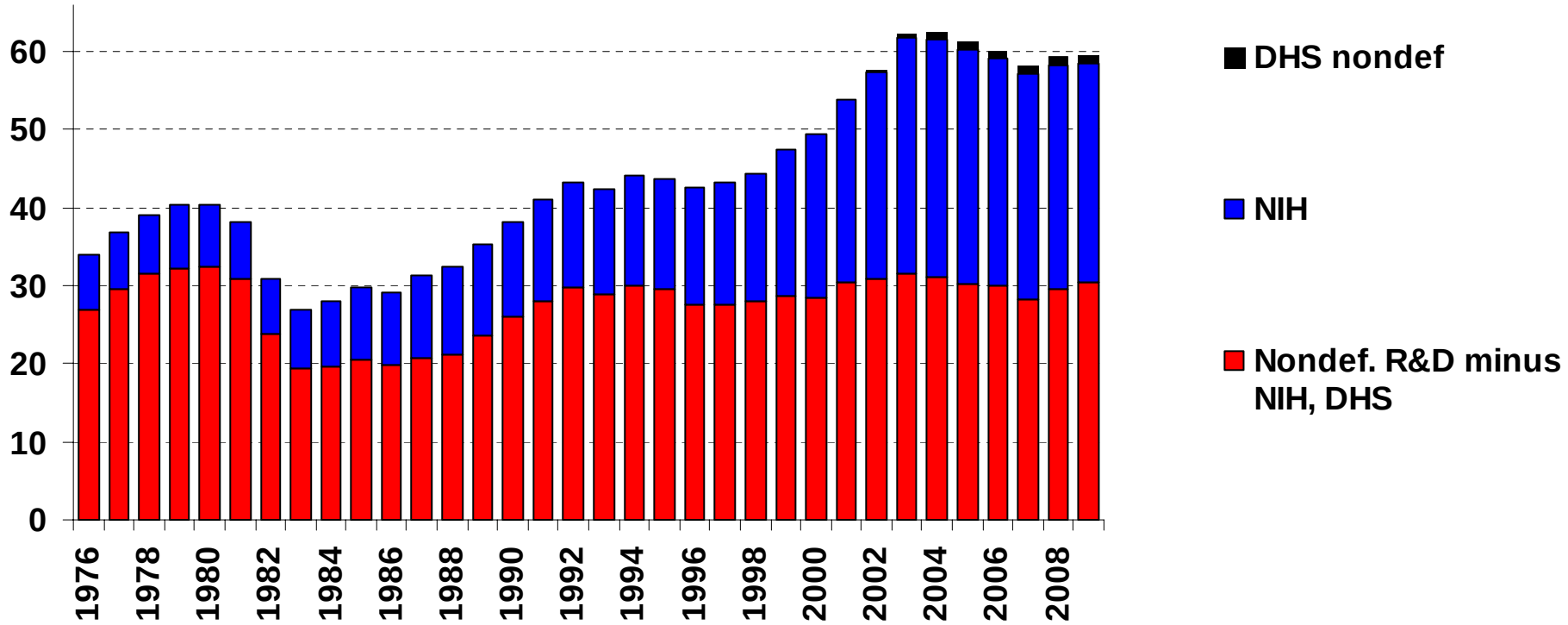
Percent Change from FY 2008



Source: AAAS, based on OMB R&D data and agency estimates for FY 2009.
DOD "S&T" = DOD R&D in "6.1" through "6.3" categories plus medical research.
DOD weapons = DOD R&D in "6.4" and higher categories.
FEB. '08 PRELIMINARY

Selected Trends in Nondefense R&D, FY 1976-2009*

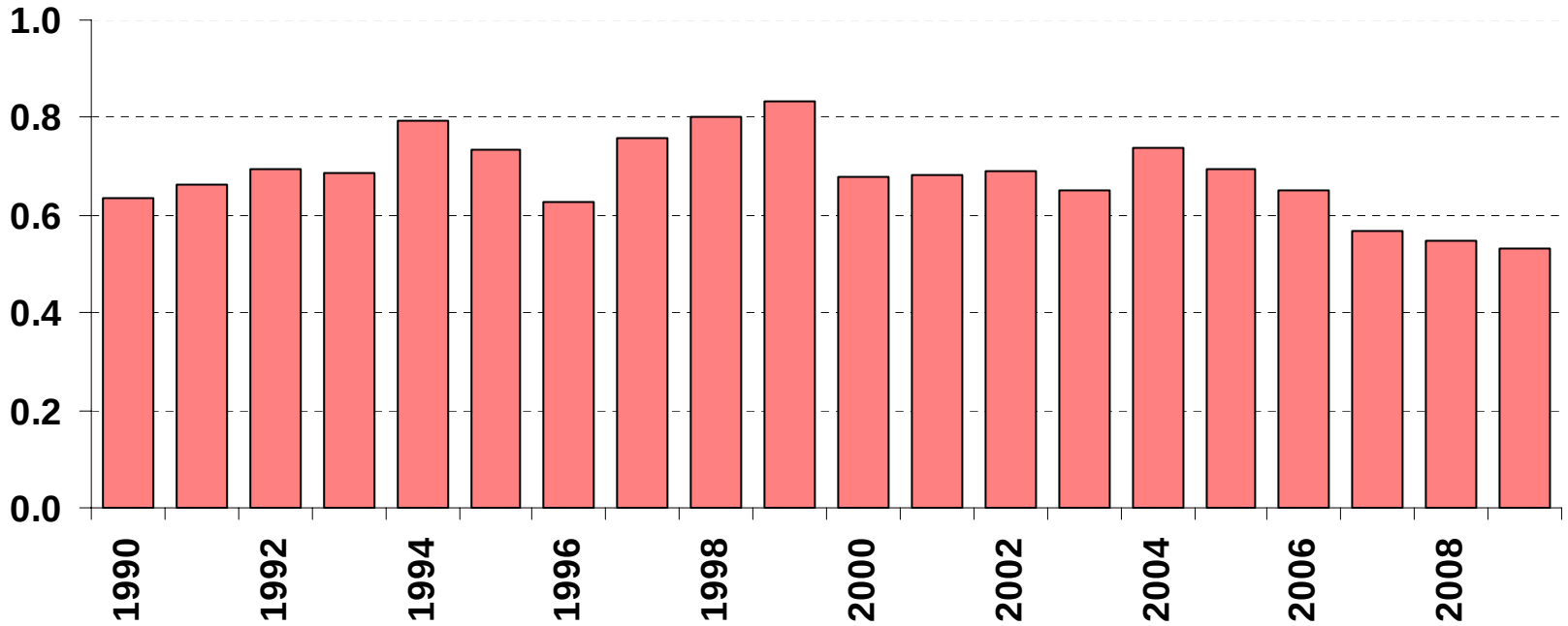
in billions of constant FY 2008 dollars



Source: AAAS analyses of R&D in *AAAS Reports VIII-XXXIII.* * FY 2009 figures are latest AAAS estimates of FY 2009 request.
R&D includes conduct of R&D and R&D facilities.

Trends in EPA R&D, FY 1990-2009 *

in billions of constant FY 2008 dollars



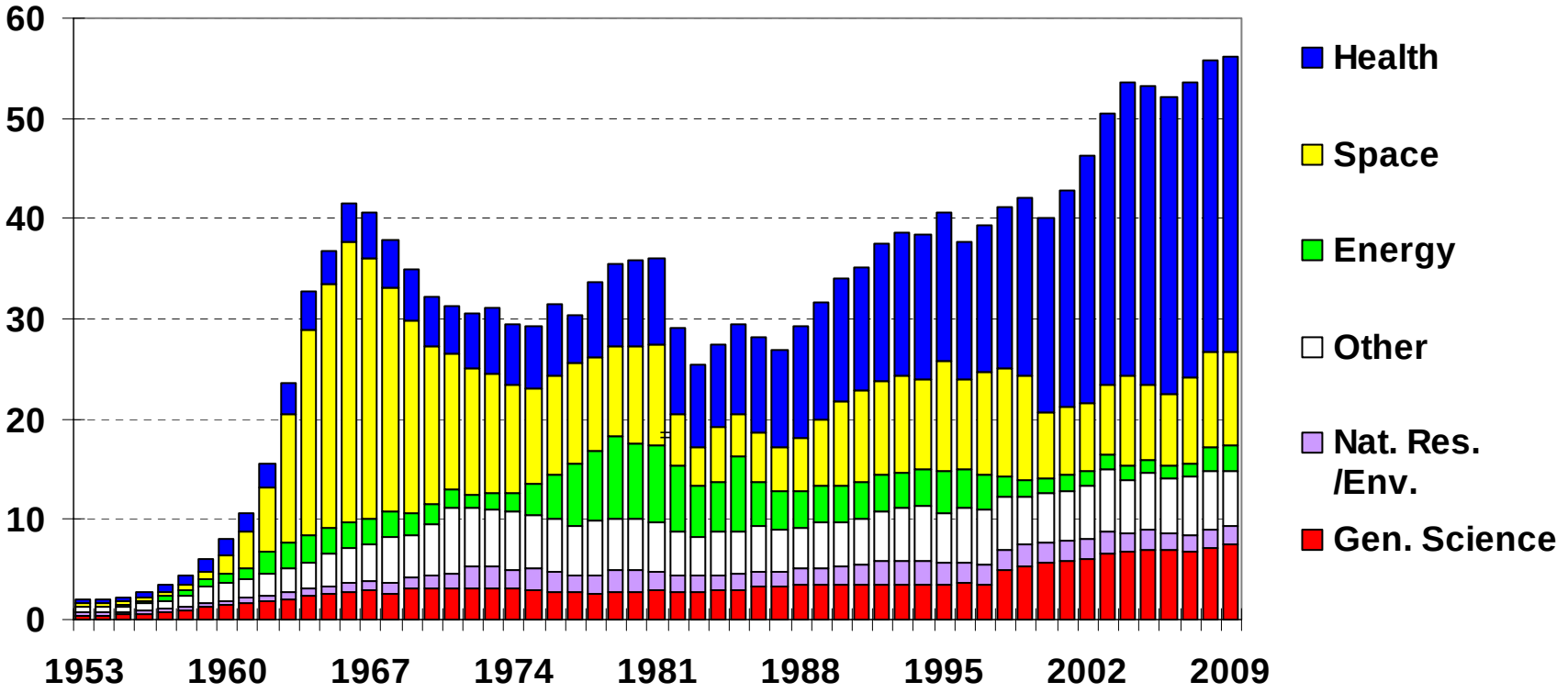
Source: AAAS analyses of R&D in *AAAS Reports VIII-XXXIII.* * FY 2009 figures are latest AAAS estimates of FY 2009 request. R&D includes conduct of R&D and R&D facilities.

ENVIRONMENTAL R&D IN THE BUDGET

- **Environmental R&D is a $2.1 billion multi-agency effort:**
  - **EPA**
  - **NOAA in Commerce**
  - **US Geological Survey in Interior**
  - **Corps of Engineers**
  - **Forest Service in USDA**
- **In addition, R&D for other missions also contributes strongly to the environment: NASA, DOE energy programs and Bio. & Env. Research, USDA, NIEHS in NIH, etc.**
- **Total federal environmental R&D approaches $8 billion.**
- **EPA and other agency research efforts focus on the environmental sciences and non-human biology.**
- **Funding trends have been downward or at best flat in recent years.**

Trends in Nondefense R&D by Function, FY 1953-2009

outlays for the conduct of R&D, billions of constant FY 2008 dollars

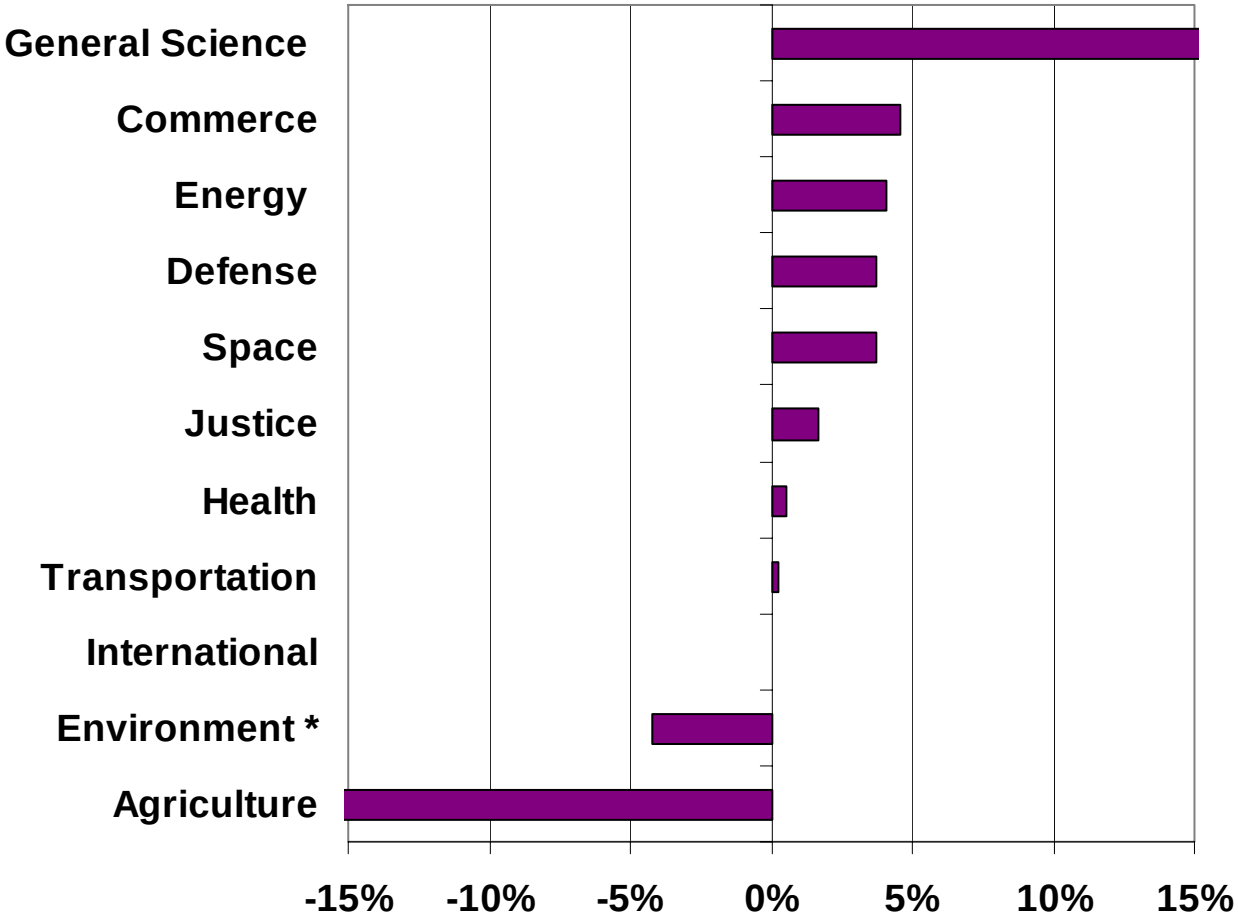


Source: AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2009.* Constant dollar conversions based on GDP deflators. FY 2009 is the President's request.

Note: Some Energy programs shifted to General Science beginning in FY 1998.

FY 2009 R&D Request by Mission (Preliminary)

Percent Change from FY 2008

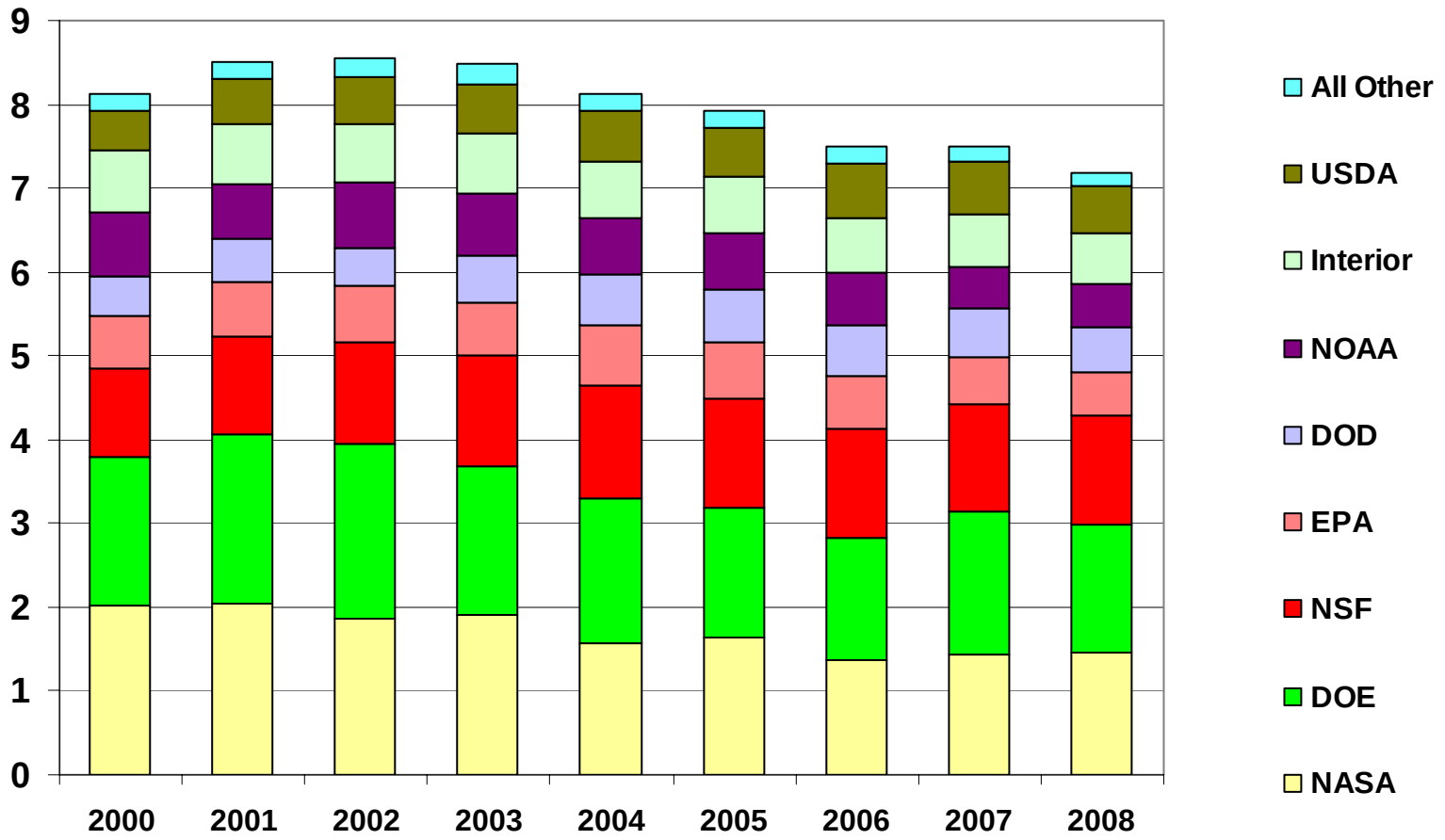


* - includes natural resources R&D

Source: AAAS, based on OMB and agency budget data.

Federal Environmental R&D, FY 2000-2008

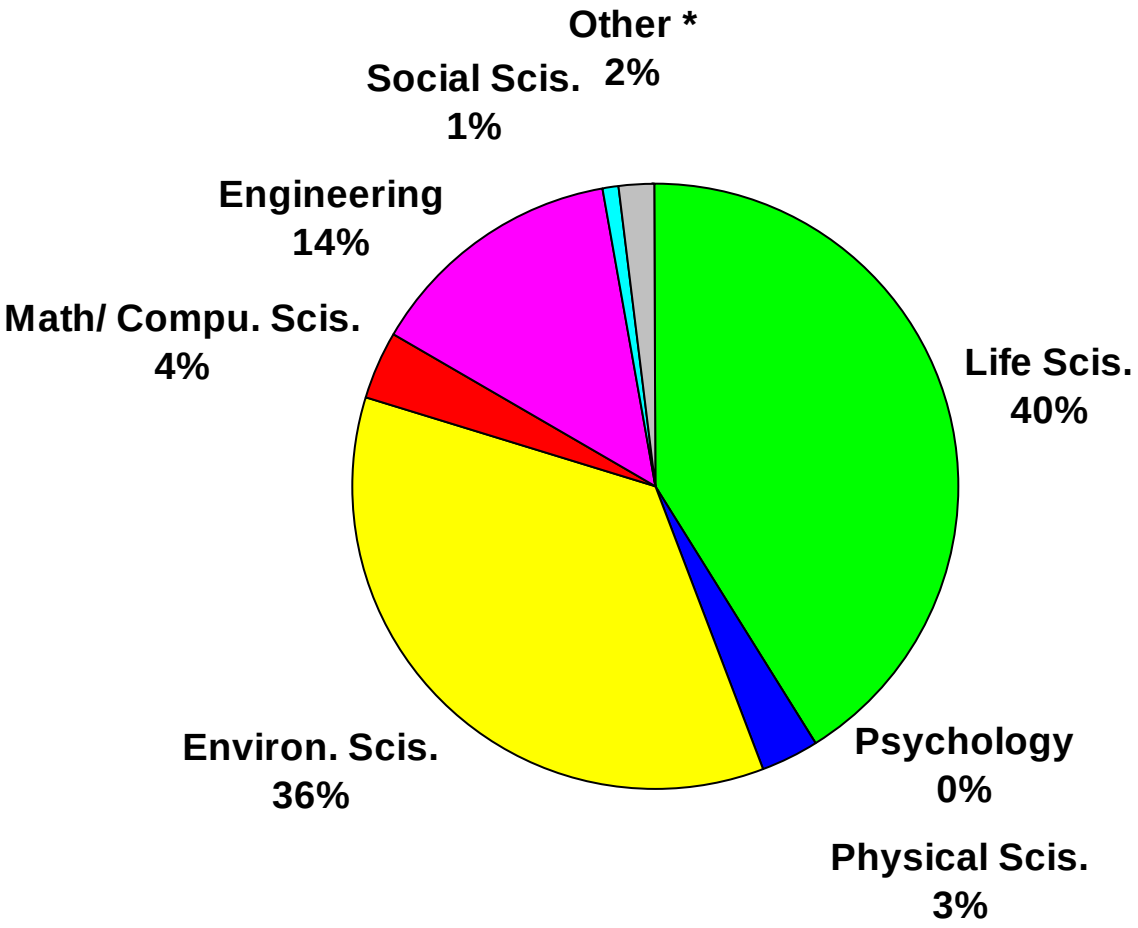
billions of constant FY 2007 dollars budget authority



Constant-dollar conversions based on OMB's GDP deflators.

EPA Research in the FY 2007 Budget, by Discipline

(preliminary obligations)



Total EPA Research Budget: $453 million

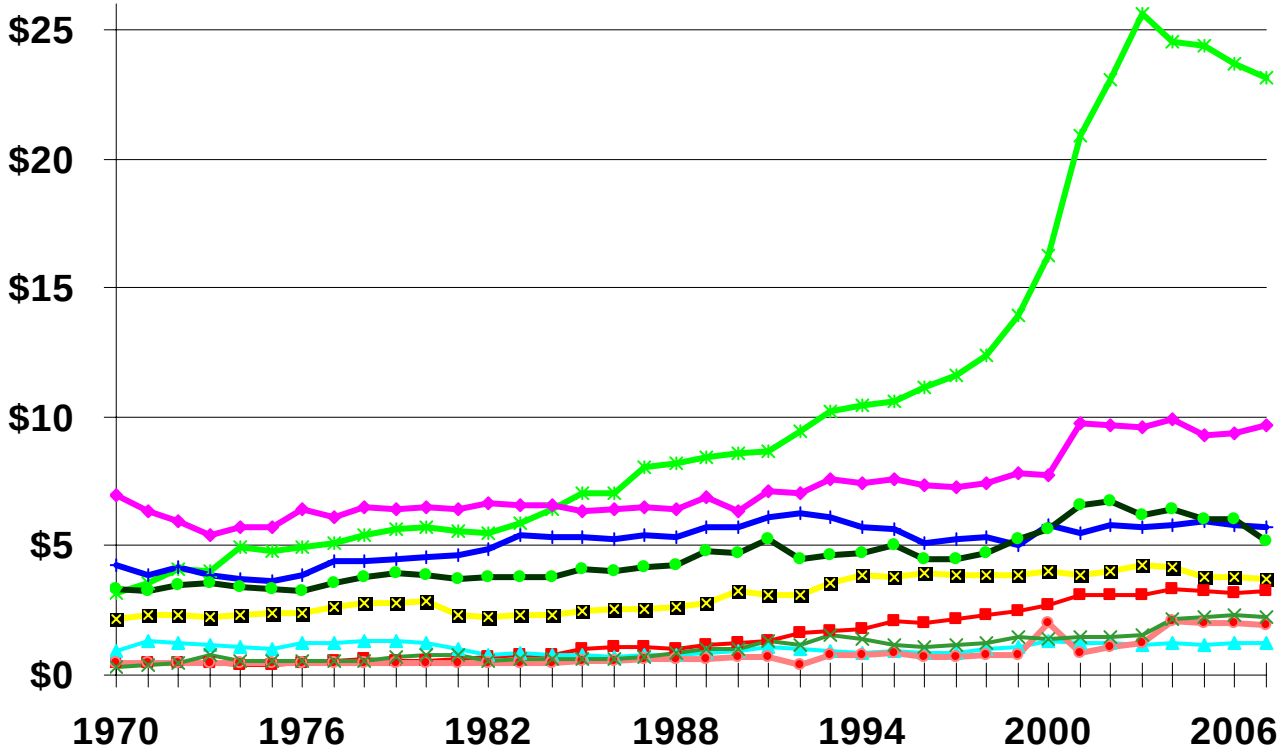
(excludes development and R&D facilities)

* - Includes sciences not classified by discipline

Source: National Science Foundation, *Federal Funds for Research and Development FY 2005, 2006, 2007,* 2008.

Trends in Federal Research by Discipline, FY 1970-2007

obligations in billions of constant FY 2008 dollars



NIH biomedical research
Engineering
Physical Scis.
All other life sciences
Env. Scis.
Math / Comp. Scis.
Social Sciences
Psychology
Other *

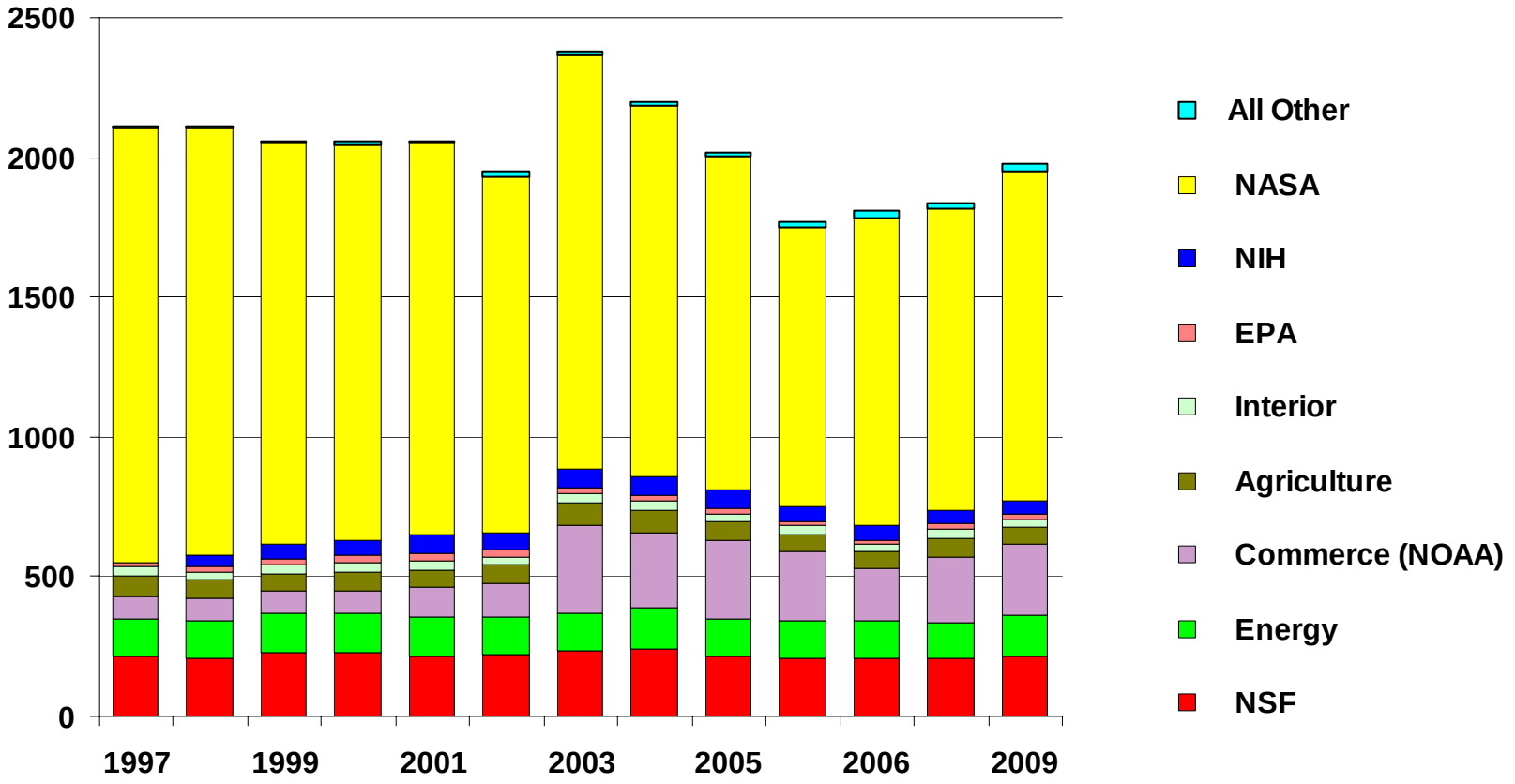
* - Other includes research not classified
(includes basic research and applied research; excludes development and R&D facilities)

Life sciences - split into NIH support for biomedical research and all other agencies' support for life sciences.
Source: National Science Foundation, *Federal Funds for Research and Development FY 2005, 2006 , 2007,* 2008. FY 2006 and 2007 data are preliminary. Constant-dollar conversions based on OMB's GDP deflators.

AAAS

Climate Change Science Program, by Agency

(budget authority in millions of constant FY 2008 dollars, FY 1997-2009)



Source: Office of Management and Budget and U.S. Global Change Research Program reports. FY 2009 figures represent President's request. NOAA and NASA figures back to 2003 have been recently revised to reflect program changes. Previous years' figures represent U.S. Global Change Research Program investments. FEB. '08

AAAS

OUTLOOK FOR THE 2009 BUDGET

Environmental R&D faces tough budgets in coming years because of extremely tight domestic spending and competition from higher priorities such as the physical sciences and space.

Many environmental R&D programs face cuts. Congress will try to boost funding for some programs, especially climate change research, but the outcome will depend on whether Congress is successful in adding more money overall for domestic appropriations.

The Appropriations Committees will try to write and pass 12 2009 appropriations bills, but Congress may delay some or all of them until the next President takes office.

FOR MORE INFORMATION…

The AAAS R&D web site is

www.aaas.org/spp/rd

The AAAS Forum on Science and Technology Policy is 8-9 May 2008 in Washington, DC

U.S. Environmental Protection Agency

FY 2009 President's Budget

Prepared for the Science Advisory Board February 28-29, 2008 Public Meeting

FY 2009 President's Budget Request

- *EPA's FY 2009 Budget Request totals $7.14 billion.*
- *The FY 2009 Request builds on past successes by:*
  - *Strengthening our protection of human health and the environment through best available science,*
  - *Continuing remediation of the most highly contaminated hazardous waste sites,*
  - *Encouraging economic development through revitalization,*
  - *Protecting the homeland and improving preparedness,*
  - *Encouraging stakeholder collaboration to address energy and climate change issues and*
  - *Demonstrating fiscal responsibility.*

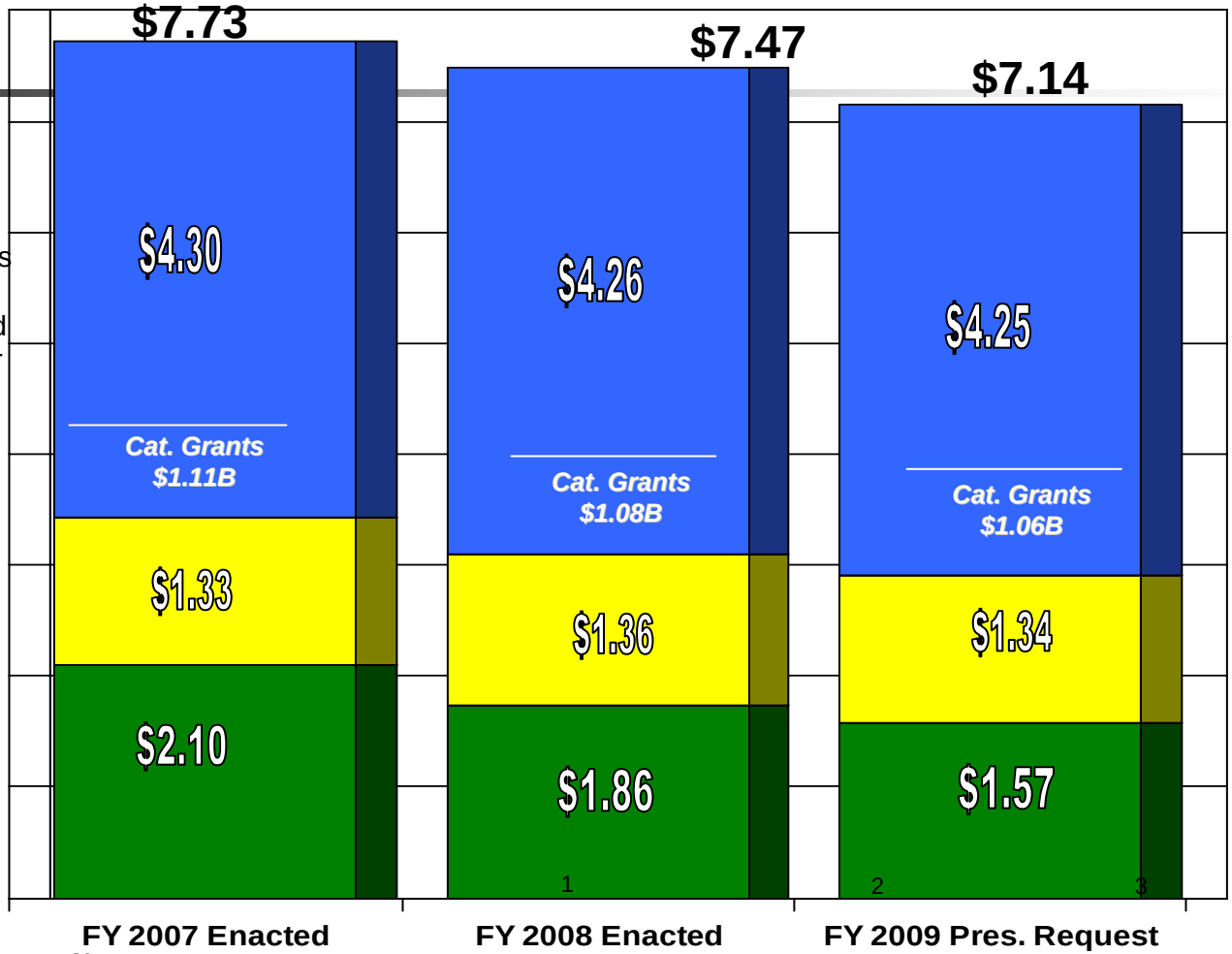
EPA's Resources by Major Category

FY 2007- FY 2009 *(Dollars in Billions)*

Operating Programs (EPM, S&T, B&F, Oil, IG, and STAG) The Agency's core regulatory, research, enforcement activities and grants to States and other partners.

Trust Funds (Superfund and LUST) Support Superfund and LUST programs.

Infrastructure Financing (STAG) Includes Clean Water State Revolving Fund, Drinking Water State Revolving Fund, Diesel Grants and Special Projects.



Notes:

Totals may not add due to rounding.

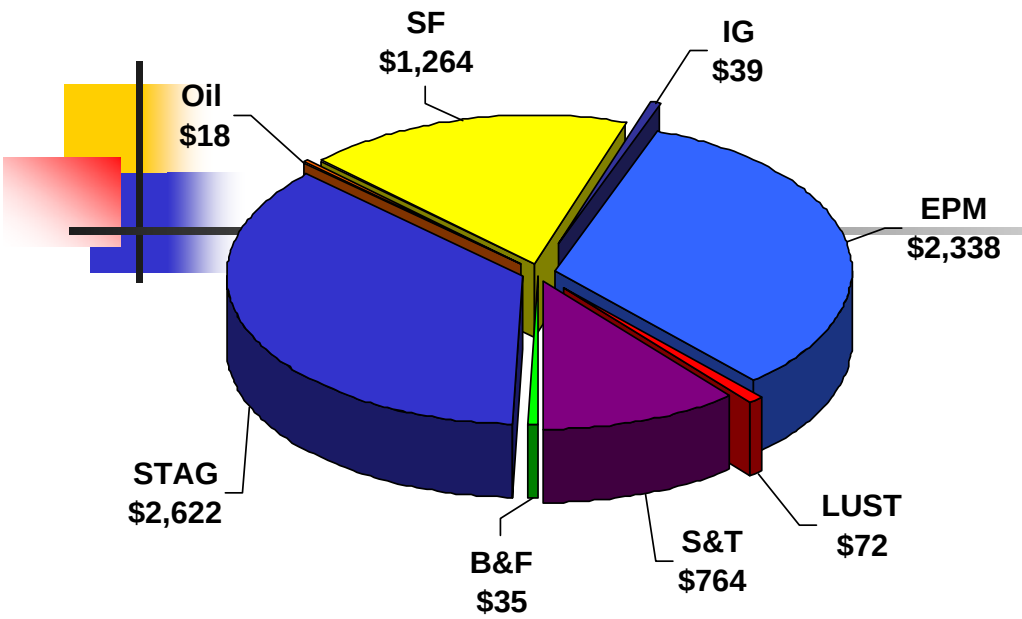
[1] FY 2008 includes a $5M rescission to prior year funding.

[2] FY 2008 Enacted includes a 1.56% rescission and a $5M rescission to prior year funds.

[3] FY 2009 President's Budget includes a $10 M rescission to prior year funds

FY 2009 Appropriation Totals

(Dollars in Millions)



FY 2009 Presidents Budget
$7.14 Billion

	FY 2007 Enacted	FY 2008 Enacted	FY 2009 [1] PresBud	08 EN to 09 PB
EPM	*$2,358*	*$2,328*	*$2,338*	*$10*
S&T (excludes SF transfer)	*$733*	*$760*	*$764*	*$3*
B&F	*$40*	*$34*	*$35*	*$1*
STAG	*$3,214*	*$2,937*	*$2,622*	*($315)*
LUST	*$72*	*$106*	*$72*	*($34)*
Oil	*$16*	*$17*	*$18*	*$1*
IG (excludes SF transfer)	*$37*	*$41*	*$39*	*($2)*
SF (includes Transfers to IG and S&T)	*$1,255*	*$1,254*	*$1,264*	*$10*
Rescission to Prior Year Funding		*($5)*	*($10)*	*($5)*
Total	***$7,725***	***$7,472***	***$7,143***	***($330)***

Notes:
Numbers may not add due to rounding
[1] Reflects FY 2008 Enacted 1.56% rescission and a $5M rescission to prior year funds.

Budget Request Highlights
FY 2009 Request

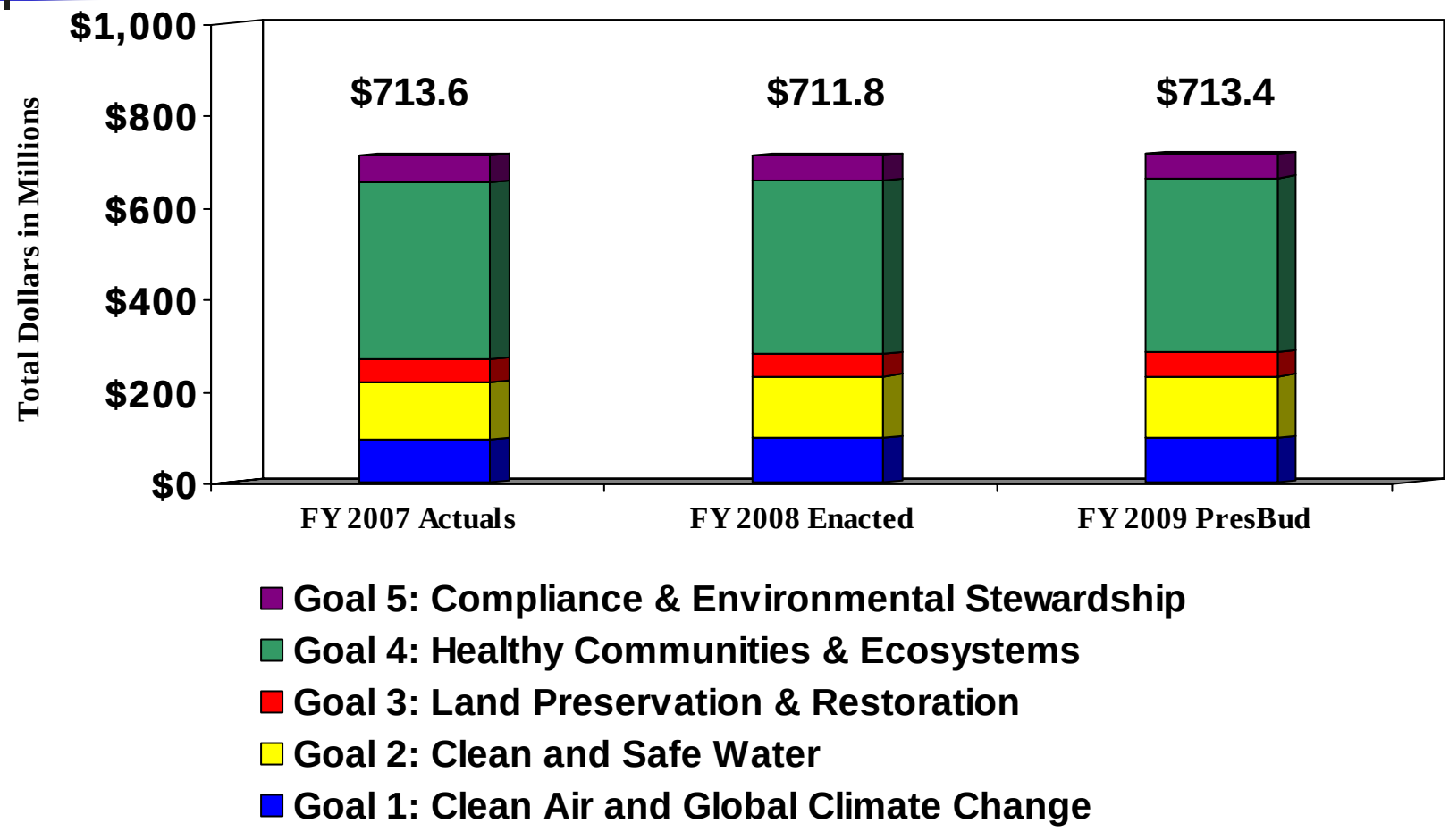
- Energy / Climate Change
  - Energy Permitting (+$14M)
  - Diesel Grants ($49M)
  - Climate Change ($115M)
- Homeland Security
  - Emergency Preparedness (+$12M)
  - Water Security (+$11M)
  - Decontamination (+$9M)

Budget Request Highlights
FY 2009 Request

- Water programs
  - Clean Water State Revolving Fund ($555M)
  - Drinking Water State Revolving Fund ($842M)
- Brownfields ($166M)
- Superfund ($1,264 M)
- Import Safety, multi-Agency ($3M)
- Enforcement programs
  - Criminal Enforcement ($52M)

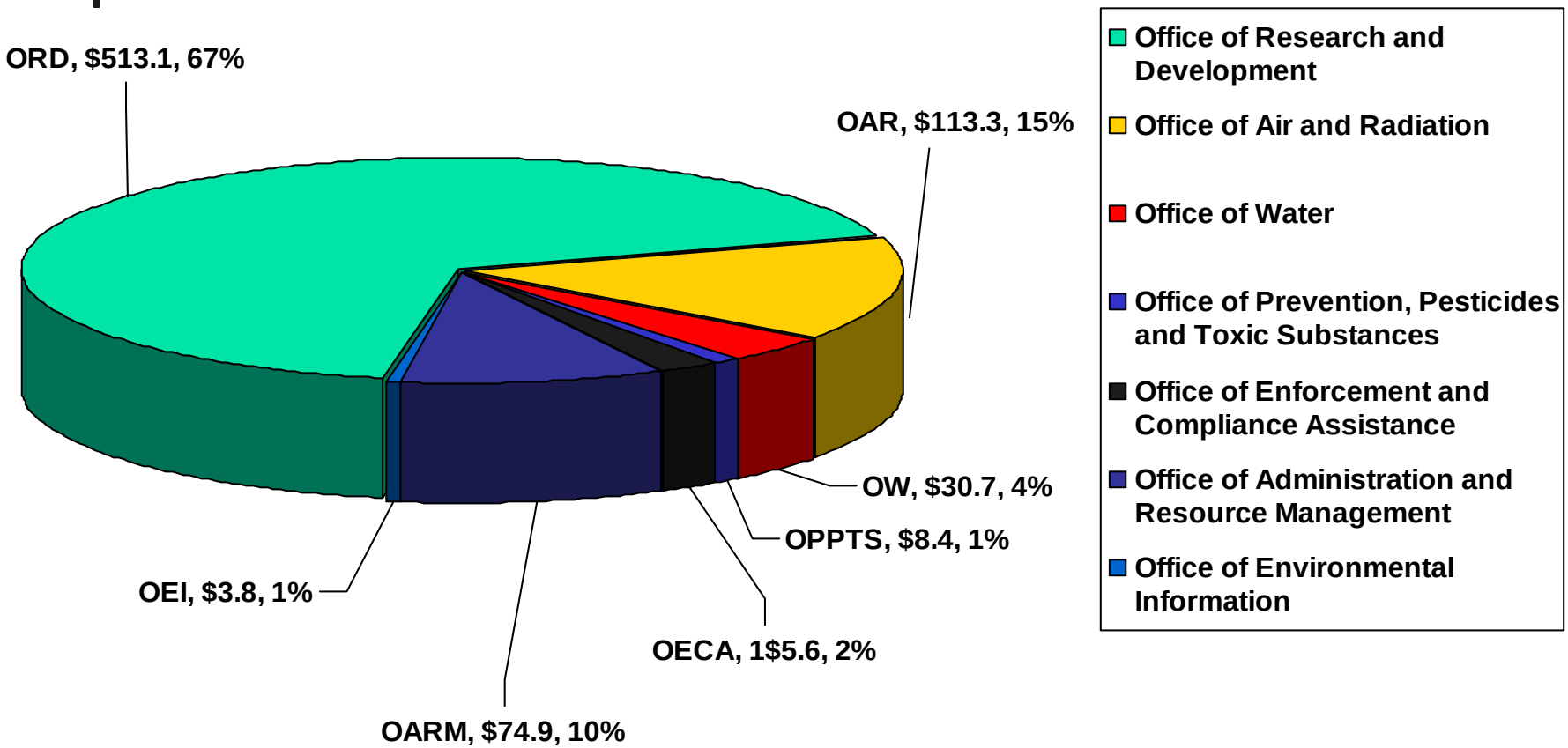
Enhance Science and Research Objective

(Dollars in Millions)



FY 2009 S&T Request by NPM

(Dollars in Millions)



FY 2009 S&T Highlights- EPA

S&T Highlights outside of the Office of Research and Development:

- A $13 million increase for Water Security Initiative pilots and Decontamination research.
- A $2.7 million increase that supports ongoing work on renewable fuel standards.

FY 2009 S&T Highlights- ORD

EPA continues to provide strong support for research addressing the Nation's most critical environmental issues, which are becoming increasingly complex. Three major highlights include:

- Nanotechnology (+$4.5 M) $4.5 M increase for a total of $14.9 M for strengthening understanding of health and ecological implications arising from new routes of exposure and/or toxicities associated with exposure to these novel materials; identifying and developing risk assessment methodologies for use by agency risk assessors; and evaluating the adequacy of current exposure assessment approaches.
- Homeland Security (+$6.3) Efforts will focus on biodefense research, including sampling and risk assessment methods and models. Increased resources also will assist in determining the best standards and technologies for field assessments.
- Computational Toxicology (+$2.7 M) Requests a total of $14.9M to improve the Agency's ability to more efficiently understand chemicals' toxicity through advanced modeling. This work also reduces the need to use animals in toxicity testing.

Major increases to research programs in the FY 2008 Omnibus not sustained in EPA's FY 2009 Request:

- $3.3 million in Global Change research.
- $3.5 million in the Drinking Water Research program.
- $8.3 million in the Human Health and Ecosystems program.

FY 2009 President's Budget

Presentation to EPA's Science Advisory Board

Kevin Y. Teichman, Ph.D.
Deputy Assistant Administrator for Science

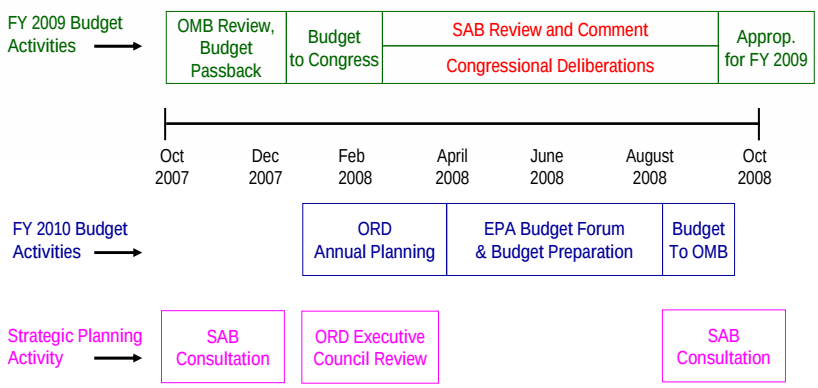
Presentation Overview

- Recent Accomplishments
- Planning and Budgeting Activities
- FY 2009 President's Budget
- Strategic Planning Activity
- Performance Evaluation
- Conclusions

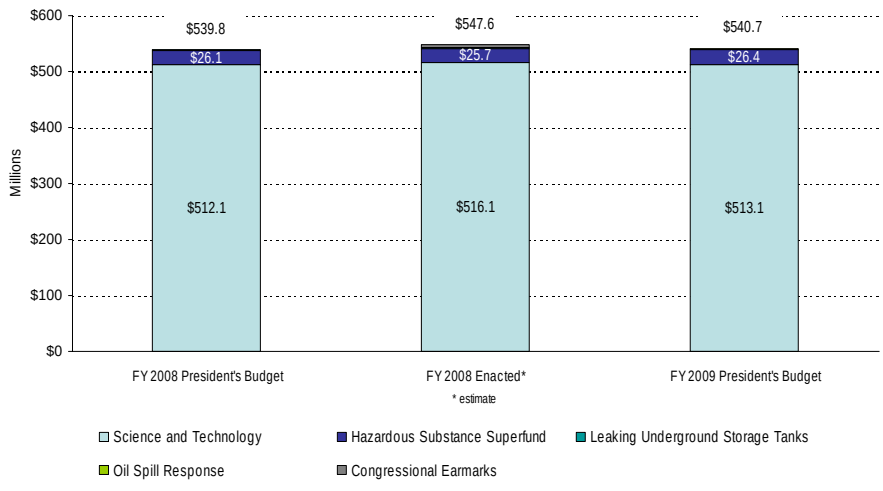
Recent Accomplishments

- Computational Toxicology: Announced 340 chemicals to be evaluated in Phase I of EPA's ToxCast project, which is developing the ability to forecast toxicity using high-throughput screening. In September, the identified chemicals were shipped from the chemical management contractor to high-throughput screening contractors, and full analysis of Phase I is expected in early 2008.
- Homeland Security: Completed development of the Threat Ensemble Vulnerability Assessment (TEVA) suite of software tools, which aids water utility operators in optimally placing sensors, detecting contamination events, and managing the resulting consequences. Recently, the Institute for Operations Research and Management Science (INFORMS) nominated TEVA as a finalist for its prestigious Edelman Award.
- Human Health Risk Assessment: Began transition to Integrated Science Assessment (ISA) in support of National Ambient Air Quality Standard (NAAQS) with Pb. The program has also just released external review drafts on the health effects ISAs for NOx and SOx.
- Endocrine Disruptors: Nearing completion of the external peer review of 12 Tier 1 assays that support the Endocrine Disruptors Screening Program. EPA will begin issuing orders this year for industry to conduct chemical screening using a combination of these assays.

Planning and Budgeting Activities
Oct. 2007 – Oct. 2008

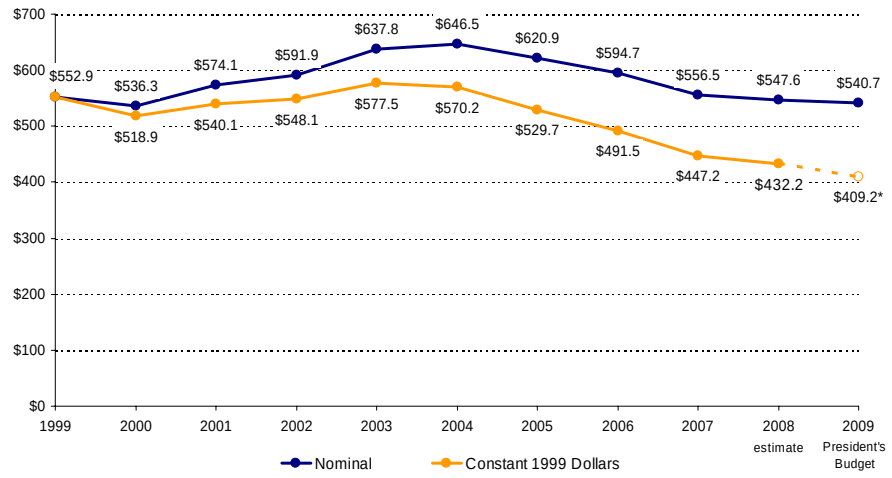


ORD Budget by Appropriation Account



ORD Budget Trend

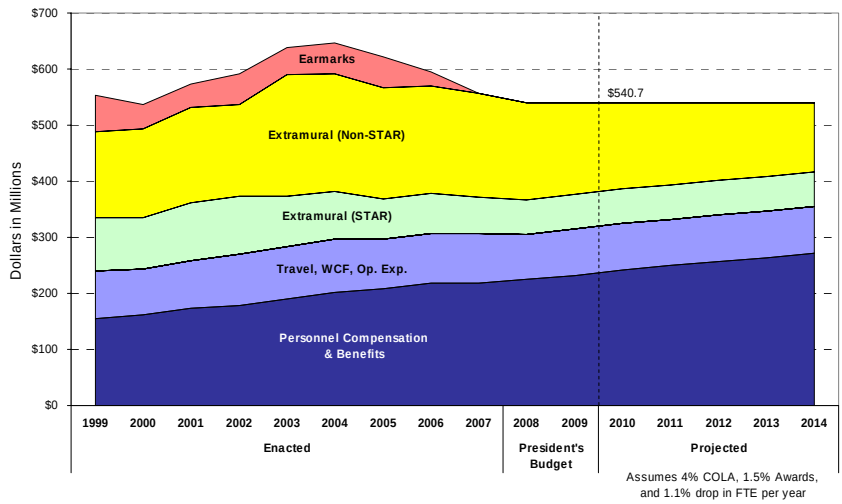
(enacted budget, includes earmarks, dollars in millions)



* FY 2009 estimate assumes January 2008 twelve month inflation rate of 4.3%.

Source: Department of Labor

ORD Budget by Type of Spending



Comparison of FY 2009 President's Request to FY 2008 Enacted Budget (Omnibus)

EPA Program/Project	FY 2008 President's Budget		FY 2008 Enacted*		FY 2009 President's Budget		Change from FY 08 En. to FY 09 PB	
	$M	FTE	$M	FTE	$M	FTE	$M	FTE
Research: Clean Air	$81.1	236.2	$80.0	236.2	$80.6	236.4	+$0.6	+0.2
Research: Drinking Water	$48.5	207.2	$48.8	207.2	$45.3	190.2	-$3.5	-17.0
Research: Water Quality	$56.5	239.4	$55.6	239.4	$56.2	236.8	+$0.6	-2.6
Research: Land Preservation and Restoration	$32.4	141.3	$31.9	141.3	$35.5	154.7	+$3.6	+13.4
Homeland Security: Preparedness, Response, and Recovery	$35.7	50.9	$33.3	50.9	$39.6	57.5	+$6.3	+6.6
Human Health Risk Assessment	$42.8	182.1	$42.2	182.1	$42.6	178.6	+$0.4	-3.5
Research: Computational Toxicology	$15.1	34.3	$12.1	34.3	$14.9	32.7	+$2.8	-1.6
Research: Endocrine Disruptors	$10.1	54.4	$10.3	54.4	$9.5	50.1	-$0.9	-4.3
Research: Global Change	$16.9	32.6	$19.7	32.6	$16.4	32.2	-$3.3	-0.4
Research: Human Health & Ecosystems	$145.0	497.0	$153.0	497.0	$144.7	478.3	-$8.3	-18.7
Research: Pesticides and Toxics	$24.8	126.3	$24.5	126.3	$26.6	137.4	+$2.1	+11.1
Research: Fellowships	$8.4	2.7	$9.8	2.7	$8.9	2.6	-$1.0	-0.1
Research: Sustainability	$22.5	76.2	$22.1	76.2	$20.0	70.8	-$2.2	-5.4
Congressional Earmarks	N.A.	N.A.	$4.3	0.0	N.A.	N.A.	-$4.3	0.0
Total	$539.8	1,880.6	$547.6	1,880.6	$540.7	1,858.3	-$7.0	-22.3

*Estimate. Totals may not add due to rounding.

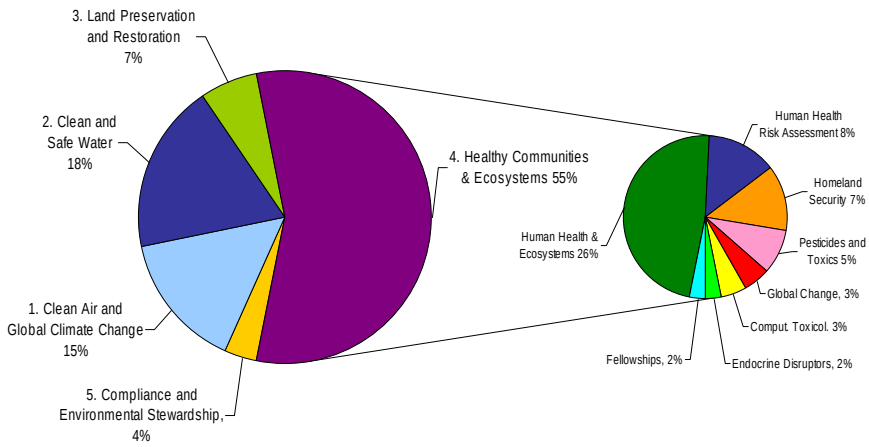
Comparison of FY 2008 President's Request to FY 2008 Enacted Budget (Omnibus)

EPA Program/Project	FY 2008 President's Budget		FY 2008 Enacted*		Change from FY 08 P.B. to FY 08 En.	
	$M	FTE	$M	FTE	$M	FTE
Research: Clean Air	$81.1	236.2	$80.0	236.2	-$1.1	0.0
Research: Drinking Water	$48.5	207.2	$48.8	207.2	+$0.3	0.0
Research: Water Quality	$56.5	239.4	$55.6	239.4	-$0.9	0.0
Research: Land Preservation and Restoration	$32.4	141.3	$31.9	141.3	-$0.5	0.0
Homeland Security: Preparedness, Response, and Recovery	$35.7	50.9	$33.3	50.9	-$2.4	0.0
Human Health Risk Assessment	$42.8	182.1	$42.2	182.1	-$0.6	0.0
Research: Computational Toxicology	$15.1	34.3	$12.1	34.3	-$3.0	0.0
Research: Endocrine Disruptors	$10.1	54.4	$10.3	54.4	+$0.2	0.0
Research: Global Change	$16.9	32.6	$19.7	32.6	+$2.8	0.0
Research: Human Health & Ecosystems	$145.0	497.0	$153.0	497.0	+$8.0	0.0
Research: Pesticides and Toxics	$24.8	126.3	$24.5	126.3	-$0.3	0.0
Research: Fellowships	$8.4	2.7	$9.8	2.7	+$1.4	0.0
Research: Sustainability	$22.5	76.2	$22.1	76.2	-$0.4	0.0
Congressional Earmarks	N.A.	N.A.	$4.3	0.0	+$4.3	0.0
Total	$539.8	1,880.6	$547.6	1,880.6	+$7.8	0.0

*Estimate. Totals may not add due to rounding.

President's FY 2009 Budget for ORD by EPA Strategic Goal

(dollars in millions, all appropriation accounts)



Clean Air +$0.6M (from $80.0M)*

- In FY 2009, the program will continue research to support the setting and implementation of the National Ambient Air Quality Standards (NAAQS), especially the standard for particulate matter.
  - The program will continue research to measure and characterize sources' emissions, track and model the fate and transport of those emissions, study exposure to air pollution, and continue epidemiological, clinical, and toxicological studies of air pollution's effects.
  - The program will also study methods to control emissions and develop techniques to evaluate past rulemakings' efficacy.
- Reduction in research that supports air quality standard setting and links sources of emissions to human exposure and health endpoints.
  - The reduction includes reduced support for Science to Achieve Results (STAR) grants on the mechanisms in the body by which particulate matter influences cardiopulmonary health.
- Offsetting increase for payroll and cost of living for FTE.

* All amounts on slides are FY09 President's Budget totals; all changes on slides are from the FY 2008 Enacted Budget.

Drinking Water −$3.5M (from $48.8M)

- In FY 2009, the program will conduct research to support EPA's Office of Water and implementation of the Safe Drinking Water Act, including revision of the Total Coliform Rule (TCR), study of the chemicals to be identified in the third generation of the Contaminate Candidate List (CCL3), and a proposed rule on underground injections such as geologic sequestration of carbon dioxide
- Research on the health effects of disinfection byproducts is approaching completion and publication.
- Resources are being redirected to support:
  - Development of provisional advisory levels within the homeland security program;
  - Research on contaminated sites and asbestos within the Land program; and
  - Studies to help develop recreational water quality criteria and evaluate emerging water contaminants in the water quality program.

Water Quality +$0.6M (from $55.6M)

- In FY 2009, the program will conduct research to support EPA's Office of Water and implementation of the Clean Water Act, including regulatory activities such as aquatic life guidelines, development of biocriteria, nutrient research, research on multiple stressors, and research to support recreational water quality criteria.
  - Increase due to technical changes including the realignment of IT, travel, and other support costs across programs.
  - These resources will support research related to criteria development, watershed management, and source control and management research.

Land Protection and Restoration +$3.6M (from $31.9M)

- In FY 2009, the program will conduct research to support cleanup of Superfund sites, including study of the transport of contaminants in ground water and the subsequent intrusion of contaminant vapors into buildings; mining and asbestos remediation; and the development of tools and techniques to accelerate site remediation.
- In support of the Resource Conservation and Recovery Act (RCRA), EPA will work with states to optimize operation and monitoring of several landfill bioreactors and determine their potential to provide alternative energy via landfill gas.
- Additional funding to:
  - Support research to determine the release points of engineered nanomaterials into the environment and the physical and chemical properties controlling the transport and transformation of nanomaterials in environmental media; and
  - Develop data to support dosimetric and toxicologic assessment of amphibole asbestos fiber-containing material from Libby, Montana.

Homeland Security +$6.3M (from $33.3M)

- In FY 2009, research will focus on developing and testing enhanced methods for detection, treatment, and containment of chemical, biological, and radiological agents intentionally introduced into drinking water and wastewater systems as well as indoor and outdoor areas.
- Increased funding to enhance biodefense research related to anthrax, including:
  - Development and adaptation of methods to test for anthrax;
  - Development of methods to effectively decontaminate anthrax in wide area environments while minimizing the generation of waste; and
  - Development and adaptation of methods and models for hazard and exposure assessments needed to determine risk-based clean-up goals for anthrax.
- Increased effort to develop provisional advisory levels (through the redirection of resources from the drinking water research program).

Human Health Risk Assessment +$0.4M (from $42.2M)

- In FY 2009, the program will support:
  - EPA's Integrated Risk Information System;
  - Development of risk assessment guidance, methods, and models; and
  - Integrated Science Assessments of criteria air pollutants to support the setting of the National Ambient Air Quality Standards.

Computational Toxicology +$2.8M (from $12.1M)

- In FY 2009, EPA will continue systems-modeling approaches for the latest biological, chemical, and exposure data for quantitative risk assessments and expects the first results from its Virtual Liver and Virtual Embryo projects.
- The program will also launch Phase II of the ToxCast program, which will evaluate up to 1,000 additional chemicals in those assays deemed most informative from the Phase I proof of concept.
- Additional funding includes support EPA's role in interagency efforts to implement recommendations in the NAS report "Toxicity Testing in the 21st Century: A Vision and a Strategy."
  - This report calls for the field of toxicology to be more efficient and predictive of chemical effects in humans, including the development of system-modeling approaches such as the Virtual Liver and Virtual Embryo projects
  - For more information, see http://www.epa.gov/comptox/.

Endocrine Disruptors −$0.9M (from $10.3M)

- In FY 2009, the program will continue research to assist EPA's program offices in reducing or preventing risks to humans and wildlife from exposures to chemicals that interfere with the function of the endocrine system.
  - Researchers will study mixtures of endocrine disrupting chemicals from concentrated animal feeding operations and water treatment plants, and finalize fish and amphibian life cycle assays for the Congressionally-mandated screening and testing program.
- Upon completing the development of validated Tiers I and II endocrine disruptor screening protocols at the end of FY 2008, resources will be redirected to support high priority investigations of the health effects of asbestos under the Land Protection and Restoration program

Global Change −$3.3M (from $19.7M)

- In FY 2009, the program will continue support for the interagency Climate Change Science Program, which will include beginning the next round of assessments mandated by the U.S. Global Change Research Act of 1990.
- The program will also continue research to understand the effects of global change on air and water quality, aquatic ecosystems, and human welfare; advance the science of global change decision support tools; and study adaptation strategies.

Human Health and Ecosystems −$8.3M (from $153.0M)

- In FY 2009, the human health research program will continue research to identify and characterize environment-related human health problems and determine exposures to and sources of agents responsible for these health concerns.
  - The program will transition from a primary focus on reducing uncertainties in risk assessment to developing and linking indicators of risk along the source-exposure-effects-disease continuum that can be used to demonstrate reductions in human risk.
- In FY 2009, the ecosystems research program will continue its gradual evolution from developing statistically-rigorous methods to assess ecological condition (EMAP) to identifying ways in which human activities impact ecosystem services and how ecosystem services benefit human well-being.
  - The results of this research will be tools that enable decision-makers who manage ecosystems to balance the protection and use of ecological resources, accounting for different geographies and time periods.

Human Health and Ecosystems (continued)

- Increase research devoted to:
  - Studying the health and ecological implications arising from new routes of exposure and/or toxicities associated with either direct or indirect exposure to nanomaterials;
  - Identifying and developing risk assessment methodologies that address the unique aspects of engineered nanomaterials; and
  - Advancing sensor-based technologies for real-time monitoring of critical chemical and biological parameters (to be developed through the Small Business Innovation Research (SBIR) program).
- Reduce research devoted to:
  - Science to Achieve Results (STAR) grants on susceptible populations not related to the children's environmental health centers;
  - Observational studies to collect exposure data and asthma research; and
  - Grants portion of the Greater Research Opportunities (GRO) program.

Pesticides and Toxics +$2.1M (from $24.5M)

- In FY 2009, the program will provide OPPTS scientific information to reduce or prevent unreasonable risks to humans, wildlife, and non-target plants from exposures to pesticides, toxic chemicals, and products of biotechnology.
- The program will develop screening and prioritization tools for major classes of pesticides and develop the scientific foundation for terrestrial ecological risk assessments.
- Additional funding will support research that moves towards an integrated, spatially-explicit risk assessment program for wildlife and plant populations and communities of concern that adds a new exposure component to existing ecological effects modeling efforts.
- Reduction in biotechnology research including efforts to develop crop management protocols to understand the impact of genetically modified crops on the environment.

Fellowships –$1.0 (from $9.9M)

- In FY 2009, the program will fund fellowships through the Science to Achieve Results (STAR) program, the Greater Research Opportunities (GRO) program, and the EPA/Marshall Scholarship program.
- In addition, EPA will host post-doctoral students through programs affiliated with the American Association for the Advancement of Science (AAAS) and the Association of Schools of Public Health (ASPH).

Sustainability –$2.2M (from $22.1M)

- In FY 2009, the program will:
  - Develop decision-support tools that promote sustainable management practices;
  - Develop metrics to gauge sustainability and inform documents such as the ROE;
  - Conduct student competitions to identify sustainable technology solutions (P3); and
  - Support commercialization of new sustainable technologies (e.g., Small Business Innovation Research, Environmental Technology Verification).
- Reduction in support for:
  - Small Business Innovation Research (SBIR) program; and
  - Development of metrics and decision support tools and the ability to assess new technologies.

Major Increases in FY 2009

- Homeland Security *+$6.3M*
- Land Preservation and Restoration *+$3.6M*
- Computational Toxicology *+$2.8M*
- Pesticides and Toxics *+$2.1M*

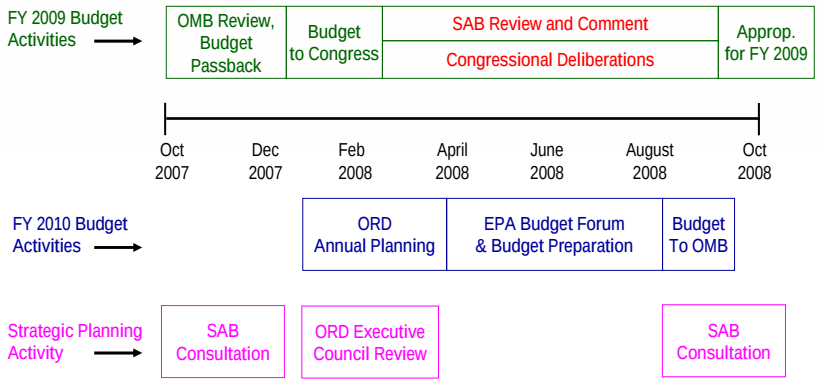
- Human Health and Ecosystems
  - Nanotechnology *+$3.6M*
  - Ecosystems *+$1.0M*

Major Decreases in FY 2009

- Congressional Earmarks *-$4.3M*
- Human Health and Ecosystems *-$8.3M*
- Drinking Water *-$3.5M*
- Global Change *-$3.3M*
- Sustainability *-$2.2M*
- Fellowships *-$1.0M*

- Pesticides and Toxics
  - Biotechnology *-$1.0M*

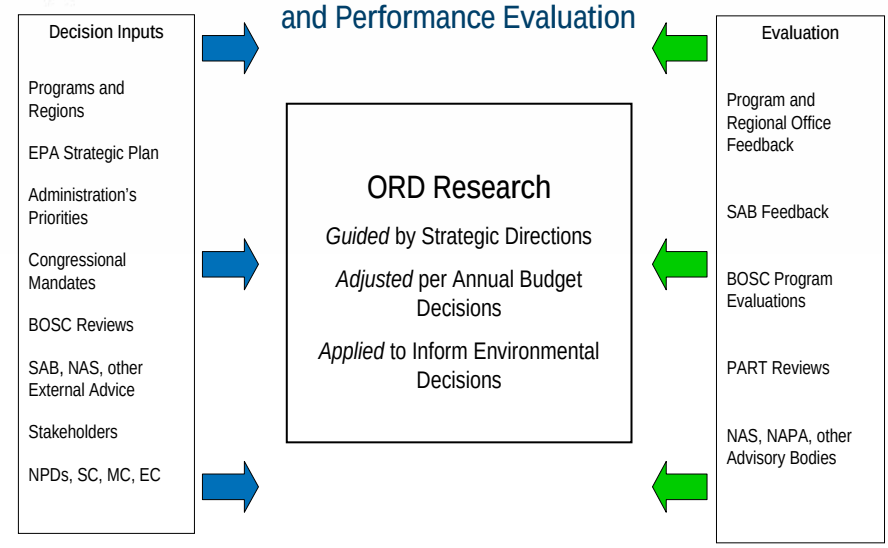
Planning and Budgeting Activities
Oct. 2007 – Oct. 2008



ORD's Strategic Planning Activity

- In addition to developing annual plans, ORD's National Program Directors have developed short write-ups of the strategic research directions they propose for their research programs.
  - These write-ups identify areas of growing, as well as decreasing, research emphasis – independent of annual budget constraints.
  - These strategic directions were presented to the SAB in October, 2007, and the comments that were provided are informing ORD's FY 2010 annual planning efforts.
- Examples of key strategic directions for ORD include:
  - Studying potential environmental impacts of geologic sequestration
  - Performing life cycle analysis of biofuels
  - Building upon our research on the transport and fate of nanomaterials to develop test methods and risk assessments for these materials
  - Evaluating the benefits of ecosystem services to human well-being
  - Increasing computational toxicology research to provide predictive models that improve our understanding of source-to-outcome linkages of chemicals

ORD's Research Program: Expert Advice and Performance Evaluation



Science Advisory Board Reviews

FY 2007

- All-Ages Lead Biokinetic Model
- Ethylene Oxide Carcinogenicity Assessment
- Report on the Environment 2006
- Report on the Environment 2007
- Acute Inhalation Exposure-Acute Reference
- Health-Based Provisional Advisory Levels for Homeland Security
- Various IRIS Assessments
- Scientific and Technological Achievement Awards STAA (2007)

FY 2008

- Science and Technology Budget Review FY09
- Strategic Directions of EPA's Research
- Ecological Risk Assessment Approach
- Acute Reference Concentration from Inhalation Exposure (ongoing)
- Ecological Research Program Strategy and Multi-year Plan
- Anthrax Technical Assistance Document
- Health-Based Provisional Advisory Levels for Homeland Security
- Scientific and Technological Achievement Awards (STAA) 2008
- Acrylamide IRIS Assessment
- Expert Elicitation White Paper
- Use of PM Research Centers

Board of Scientific Counselors Reviews

FY 2007

- Safe Pesticides/Safe Products Program Review
- Human Health Mid-Cycle Review
- Ecological Mid-Cycle Review
- Drinking Water Mid-Cycle Review
- 2006 National Center for Computational Toxicology Review
- Sustainability Program Review (began)
- Endocrine Disrupting Chemicals Mid-Cycle Review (began)
- Air Mid-Cycle Review (began)
- National Center for Environmental Research Communications (began)

FY 2008

- Sustainability Program Review (completed)
- Endocrine Disrupting Chemicals Mid-Cycle Review (completed)
- Air Mid-Cycle Review (completed)
- National Center for Environmental Research, Communications (completed)
- Human Health Risk Assessment Program Review
- National Exposure Research Lab, Strategic Directions
- 2007 National Center for Computational Toxicology Review
- Global Change Mid-Cycle Review
- Homeland Security Program Review
- Land Mid-Cycle Review
- Water Quality Mid-Cycle Review (begin)

OMB PART Reviews of ORD Programs

- 2003
  - Pollution Prevention / New Technologies – Results Not Demonstrated
  - National Ambient Air Quality Standards – Results Not Demonstrated
  - Ecological Research – Results Not Demonstrated
- 2004
  - Endocrine Disruptors Research (Joint PART with OPPTS) – Adequate
- 2005
  - Human Health Research – Adequate
  - Drinking Water Research – Adequate
  - National Ambient Air Quality Standards (re-PART) – Adequate
  - Ecological Research (re-PART) – Ineffective
- 2006
  - Global Change Research – Adequate
  - Land Protection and Restoration Research – Adequate
  - Water Quality Research – Adequate
  - Human Health Risk Assessment Program – Moderately Effective
- 2007
  - Pesticides and Toxics Research – Moderately Effective
  - Ecological Research – Moderately Effective

ORD Progress in Accountability

- "Moderately Effective" Ratings on 2007 PART Reviews
  - Strong improvement from previous years
  - Agreement on BOSC rating process
  - Better standardized process within ORD for demonstrating program structure and results
- Success in Addressing the President's Management Agenda
  - ORD's adoption of efficiency measures instrumental in Agency receiving "Green" rating
- EPA-Sponsored NAS Study on Efficiency Measurement for Research Programs
  - For meaningful assessment of research efficiency, NAS recommends dual approach:
    - Develop "process" efficiency measures linked to outputs
    - Incorporate "investment" efficiency into independent reviews of program quality, relevance, and performance

Comments from Last Year's SAB Review

- Concern over ORD's declining budget, in particular funding for ecosystems research.
  - EPA believes that the FY 2009 proposed budget addresses the Agency's highest priority environmental research needs given available resources.
  - EPA's Ecosystems Research Program is focusing on tools that enable decision-makers who manage ecosystems to consider the value of ecosystem services and thereby balance the protection and use of ecological resources.
- Concern over the potential for erosion in staff morale.
  - In March, 2007, *The Scientist* ranked EPA's RTP campus the third best place for postdoctoral fellows to work, according to survey data.[1]
  - OPM's *2006 Federal Human Capital Survey* found slight increases in employees' overall satisfaction with their jobs (Question 60).[2]
- Concerns that inflating personnel costs may eat into research budgets.
  - ORD is restructuring its administrative functions to recoup valuable resources while maintaining or improving levels of service.

[1] Source: http://www.the-scientist.com/2007/3/1/49/1/

[2] Source: http://www.fhcs.opm.gov/

Cross-Program and Program-Targeted Research

Cross-Program Research

- Research with broad applications and implications for multiple offices
- Issue is persistent such that priorities remain fairly stable, but continually need to improve the science to address the priority
- Applies emerging approaches and tools
- Incubator for innovation ideas to addressing long-standing issues
- Double "bang for the buck" by selecting stressors to address a cross-programs issue that will also inform a program-targeted effort

Program-Targeted Research

- Often a single or primary client
- Research may be legislatively mandated, with deadlines
- Priorities may shift based on changing program needs
- Often employs established methodologies

Computational Toxicology: Example of the Complementary Nature of Cross-Program and Program-Targeted Research

ORD is conducting research toward understanding the toxicity of the conazole class of pesticides. While this research is providing direct benefit to EPA's Office of Pesticide Programs, it is also serving as a proof-of-concept activity in ORD's ongoing effort to develop a generalizable capability to apply genomics-based computational approaches to environmental toxicology.

SAB Cross-Cutting Issues

- Global Change
- Sensitive Populations
- Urban Sprawl
- Environmental Disasters

- Others?

Global Change

In addition to the Global Change Research efforts,

- Drinking Water Research
  - Studying potential implications of geologic sequestration to control CO2 emissions
  - Evaluating impacts of biofuels on sources of drinking water and water use practices (in collaboration with USDA)
  - Evaluating water quality/quantity changes and best management practices for protecting drinking water sources
- Ecological Research
  - Imposing climate change scenarios on alternative future management options
  - Conducting place-based projects in the Coastal Carolinas and Tampa Bay that consider climate change as a critical stressor for consideration in future management options

Sensitive Populations

- Human Health Research is evaluating susceptibility by life stage, particularly prenatal development and children's health.
- Air Research is performing studies that involve various ages (e.g., young children, elderly) and different conditions (e.g., asthma, cardiopulmonary disease).
- Drinking Water Research includes evaluating reaction of sensitive populations to contaminants (e.g., exposure of infants to nitrate, reproductive health effects of disinfection byproducts, exposure of children to viruses).
- Water Quality Research includes research to support recreational water criteria development, an analysis of childhood exposures, since they demonstrate higher swimming related illness rates.
- EDCs and SP2 Research includes participating in validation of 19 different in vitro and in vivo assays for the EDC screening program and developing assays to screen chemicals for their potential developmental neurotoxicity

Urban Sprawl

- Ecological Research is quantifying the impact of development on ecosystem services in place-based projects; Tampa Bay and the Carolinas are primary sites.
- Air Research is conducting near-roadway studies that provide exposure and health data relating to road and traffic densities.
  - The results of this research will be used in urban planning models and provide inform Green Community design.
- Both Drinking Water and Water Quality Research are evaluating approaches for sustainable infrastructure (asset management for water distribution systems; innovative techniques for managing water conveyance and storage systems), and studying watershed management approaches (e.g., geospatial analysis for smart growth, impacts of urban activities on ground water quality).
- Land program is shifting resources into brownfields research. Topics include a land-use decision support tools (SMARTe) and vapor intrusion into buildings.

Environmental Disasters

In addition to related Homeland Security Research efforts,

- Water Quality Research is conducting research on non-point source related health risks associated with wet weather events, with specific emphasis on the effectiveness of disinfecting blended effluents.
- Land Research is conducting research that addresses wastes from natural and anthropogenic disasters.
- Human Health Research is clarifying the relationship between exposure to mold and the exacerbation of asthma to inform responses to and recovery from flood and water damage.
- Ecological Research is considering natural vs. anthropogenic influence on ecosystem services.

Conclusions

- ORD research program plays a vital role in ensuring that EPA meets its mission to protect public health and the environment.
- Our research program has been evaluated and found effective by both independent, external experts and by OMB.
- The FY 2009 budget appropriation enables EPA to meet the President's highest environmental priorities.
- Through strategic planning, we are positioning our research program to anticipate and be responsive to future environmental challenges.

ATTACHMENT H

US EPA SCIENCE ADVISORY BOARD
STRATEGIC RESEARCH DIRECTION - TEAM ASSIGNMENTS

SAB Chair: Dr. Granger Morgan

HUMAN HEALTH TEAM

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Dr. Thomas Burke
Dr. Deborah Cory-Slechta
Dr. Steve Heeringa
Dr. Agnes Kane
Dr. Meryl Karol
Dr. George Lambert
Dr. Melanie Marty
Dr. Steve Roberts
Dr. Kristin Shrader-Frechette
Dr. Lauren Zeise
DFO: Suhair Shallal

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Dr. Kenneth Dickson
Dr. Baruch Fischhoff
Dr. Judith Meyer
Dr. Joan Rose
Dr. James Sanders
Dr. Philip Singer
Dr. Deborah Swackhamer
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Dr. Kerry Smith
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Dr. Rogene Henderson
Dr. Jill Lipotti
Dr. Jana Milford
DFO: Mr. Fred Butterfield

TECHNOLOGY TEAM

Dr. David Dzombak
Dr. James Johnson
Dr. Valerie Thomas
Dr. Jerald Schnoor
Dr. Bernd Kahn
Dr. Michael McFarland
DFO: Ms. Kathleen White

February 27, 2008

Overview and Update on the SAB Project on Valuing the Protection of Ecological Systems and Services

- The SAB initiated this project in 2003 to:
  - assess EPA ecological valuation needs,
  - assess the state of the art and science of valuing protection of ecological systems and services ,and
  - identify key areas for improving knowledge, methodologies, practice, and research
- Draft report is an original SAB study

1

To develop the draft report, the committee…

- Held multiple face-to-face meetings to discuss
  - Concept of value and valuation
  - Approaches to valuation
- Conducted interviews with Agency managers and staff involved in ecological valuation for national rulemaking
- Held fact-finding meetings in Regions 5 and 9; drew from an SAB Staff Office survey of regional practices and needs
- Worked on case studies and interacted with EPA staff in program and regional offices

2

The Committee also…

- Led a 2005 SAB workshop involving EPA managers and senior scientists and scientists from other federal agencies, environmental groups, business entities and international organizations
- Provided a 2005 advisory on EPA's draft *Ecological Benefits Assessment Strategic Plan*

3

Different from other recent reports on ecological valuation

- Focus on *EPA needs* for improved valuation
  - National rulemaking
  - Regional partnerships
  - Site-specific decision-making
- Multi-disciplinary approach to ecological valuation
  - Predicting effects on ecological systems and services
  - Multiple methods for assessing value, appropriate to context
  - Cross-cutting issues associated with uncertainty, communication, and deliberative methods

4

What's new in the report: major recommendations (1)

- EPA should cover an expanded range of important ecological effects
  - Analyses should be driven by conceptual models of ecosystems and ecosystem services, not what has worked in the past or available data
- Valuation analyses should involve
  - Interdisciplinary collaboration among physical/biological and social scientists throughout the valuation process
  - Early and appropriate input from public about ecological services

5

What's new in the report: major recommendations (2)

- Importance of enhanced science to identify and develop measures of ecosystem services
  - EPA should seek to use ecological production functions for valuation wherever practical

6

What's new in the report: recommendations (3)

- EPA should experiment, where appropriate and valuable, not only with economic valuation methods (the current mainstay of ecological valuation at EPA) but also with other valuation methods (e.g., decision-science methods, citizen juries)
  - EPA should be transparent about the reasons for choosing specific valuation methods and communicate clearly what the methods measure and do not measure

7

To prepare for chartered SAB review in May 2008…

- The draft report received an independent informal review from an economist, ecologist, and social scientist in November 2007
- The committee will provide a lay version of the report to supplement the technical report
- The committee plans to supplement the technical report with detailed web-accessible information on valuation methods

8

When you read the report, we would appreciate your thoughts about…

- Communicating the report's findings to EPA and others interested in or affected by ecological valuation
- Research initiatives to address data and information gaps discussed in the report

Attachment J
D R A F T – Do Not Quote or Cite
Preliminary Comments
SAB Conference - February 29th, 2008

1. Human Health Break Out Group:

(Note: This area contains some ecosystems research)

a) Dr. Jim Bus:

Report of Chartered SAB Human Health Budget Breakout Group

Areas discussed: Human Health, Computational Toxicology, Endocrine Disruptors, Safe Pesticides/Safe Products, and Human Health Risk Assessment

The Human Health area is proposed for an overall 6% reduction in budget funding. This funding proposal will likely be insufficient to effectively evaluate and implement the monumental changes in biological sciences the Agency is facing in the years ahead. The rapid emergence of toxicogenomic and computational sciences is significantly impacting not only the expectations of how the Agency will test environmental contaminants for health and environmental effects, but also how it will translate these test results to quantitation of human health risks. In addition, due to progress in reducing environmental levels of individual contaminant compounds, SAB believes that future health evaluations conducted by EPA will need to address the scientifically more challenging problem of evaluating cumulative health risks associated with low-level exposures to complex mixtures of chemicals.

Implementation of these challenges will require access to significantly expanded and changed expertise and technology resources both inside and outside of EPA. Meeting these expectations will require access to new skill sets that also will need to be highly integrated. These include molecular biology, computational modeling, information technology, database management and maintenance, exposure modeling, clinical epidemiology, and risk evaluation and communication. Increased resources will need to be directed to rapidly building capacity in these areas in the agency.

The complexity and rapid change of the emerging sciences also demands that the Agency engage stable partnerships and collaborations with other federal agencies, the external academic and private scientific communities, and other societal stakeholders. It is not reasonable or efficient to expect that EPA be entirely self-sufficient in the implementation of the future complex testing and risk evaluation paradigm. Thus, EPA must have access to longer-term external funding commitments that are not vulnerable year-to-year fluctuations associated with current shorter-term funding strategies. External research resources will be critical to importing needed research tools and technologies into Agency research strategies, as well as to assure adequate opportunities for regular stakeholder dialogues and scientific oversight of EPA's strategic science direction.

b) Computational Toxicology

c) Endocrine Disruptors

d) Safe Pesticides/Safe Products

e) Human Health Risk Assessment

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2 - Ecosystems, Water, and Security Research

Ecosystems, Water and Security Research
(Swackhamer, Rose, Dale, Dickson, Sanders)

A. Programs have been exceptional at being nimble given the shrinking resources; they are encouraged to continue to organize with this in mind.

B. Program emphasis is almost entirely focused on what is needed today; they must devote some effort and resources to future and emerging concerns.

C. After years of significant budget cuts (Ecosystems) and overall budget erosion, the programs are running lean and mean – thus even a small investment would go a long way.

D. Programs are commended at doing a great job of being creative at leveraging outside partners (e.g. Ecosystems working with National Geographic on mapping ecosystem services)

E.The practice of "open source science" to be encouraged.

F. It is imperative to keep the climate change stressor explicit in all their research (water quality is not, for instance)

G.. Reduction in the STAR grants program (which has been the approach to address future science) means that understanding emerging issues and investment in research that can assist the agency in addressing the future are limited.

H.Education/outreach – crucial – needs to be addressed more.

I. Overall, given the highly constrained budget environment, the research priorities and available funding choices are for most part in alignment, and choices have been made in a

thoughtful way. However, resources for the science in all these programs, especially ecosystems, are inadequate to address all the issues they need to be addressing – they are only able to address the tips of the icebergs. The programs are down to bone, and our ability to protect the environment and position us to address coming environmental threats is extremely compromised.

General Comment unrelated to these areas: (Swackhamer)

- **Reduction in the STAR Fellowships program is counter to the need to develop future environmental leaders and scientists to replace the rapidly retiring workforce**

a) Drinking Water

Drinking Water (Swackhamer)

The budget for DW has decreased by $3.5M. Explanations for this are completion of the DBP work and arsenic rule making. There was a demo program for small communities and as the As rule was finished, this is being phased out. For, DBPs, a four laboratory study has been completed and is about to be published, looking at non-cancer effects, and thus this is being phased out.

However, only 9 of the DBPs are regulated, but there are more than one hundred DBPs identified. Thus work in this are should not be phased out. Furthermore, the CCL is still a major rule which will need to be addressed. Finally, research is not being directed to new contaminant issues in water.

An Omnibus $1M was appropriated for the geoCseq – effect on DW by Congress, but has been removed in FY09. DW is working with CC and air program to begin to address this; also will issue some STAR grants in 08. Without further investment in FY09 this investment will be lost.
Total coliform revised rule is on the fast track and is due out by the end of the summer, may be expanded to be a broader distribution rule. There clearly are not enough resources being put into this important area considering the infrastructure and the hundreds of boil orders occurring (eg. West Palm Beach). Biofilms will be a big area for research needs.

Yes, priorities have been driven by statutory needs, but the agency can only do emerging issues on fringes.

Issues not being addressed: nanomaterials in DW, in terms of distribution systems, technology associated water treatment based nano is not being addressed – technology research related to nano applications is not being done The DW program will have to leverage the work in HLS regarding biosensors and MRA.

Drinking water probably remains one of the most important exposure routes and decreases in funding this area has the potential to effect directly the health of millions of citizens.

b) Homeland Security

Dr. Jill Lipoti - Homeland Security/ Social Science

One of the Homeland Security activities in the Land Preservation area, is the training of volunteers to serve in the Response Support Corps or as part if an Incident Management Team. The agency estimates that it will need between 3,000 and 3,500 members to respond to five incidents of national significance. The FY09 budget provides funds to train 700 of these individuals. However, research has shown that only 50% of volunteers can be relied upon to respond to incidents, so the number of volunteers to be trained should be at least doubled, even without taking into account normal attrition. The agency should pursue social science research to identify the barriers to volunteer participation in incidents.

Homeland Security (Swackhamer)

Homeland Security research programs continue to expand in FY 2009. Programs underway and under development are in response to Presidential Directives to ensure comprehensive surveillance, monitoring, and decontamination within the environment, and appear appropriately focused. As detection and sensor techniques continue to mature, research is expanding into detection and treatment of possible future events that could occur in indoor and outdoor areas. A focus on anthrax builds from existing research programs dealing with chemical, biological and radiological agents. Considerable challenges still remain in the areas of risk communication and particularly with surveillance and decontamination issues arising from potential wide-scale events.

c) Ecological Research

Ecological Services

The long term erosion of funding to ecological research is of great concern to the SAB. Funding has decreased from $102 million in 1995 to $60 million in 2009, a decrease of 36%. Considering that ecosystem goods and services provide the natural infrastructure supporting the health and wellbeing of our society, it is essential for EPA to conduct ecological research to understand how stressors affect ecological services.

We commend EPA for being creative in developing and initiating a strategic research program on ecological services. The program includes research on measuring and monitoring services, mapping services at different special scales, development of modeling tools, creation of case studies and focusing initially on wetlands and nitrogen. However, it is unfortunate that funding is not adequate to address the important areas of development of decision support systems relationships of ecological service research to human wellbeing, education of the public about the importance of ecological services, and implementation of research on valuation approaches. We encourage increased funding to EPA for the Ecological Services Program to develop robust research initiatives in these areas. We also commend EPA for developing partners and being innovative in exploring open source science approaches to catalyze further research on ecological services.

d) Water Quality

Dr. Deborah Swackhamer

This is a lean time for ORD's research in water quality in the face of a declining budget and an ongoing lawsuit dealing with recreational waters microbial standards that is soaking up staff time and other resources. The Agency has responded by slowing down activities across the program and working with the OW. No project is being eliminated. Yet, there is no work on how water quality is affected by nanotechnology or by climate change or how water quantity may be affected by water consumption. They are not addressing the growing concern of pharmaceuticals in surface waters.

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3 - Economics and Sustainability:

a) Economics and Decision Sciences

Dr. James Hammitt - Economics & Decision Sciences

EDS research has been shifted from ORD into NCEE and the external research budget is no longer included in S&T. The budget has declined sharply from more than $2M several years ago to $1.1M in FY2007 to approximately $600,000 in FY2008. This remaining budget is likely to be directed toward issues of evaluating ecosystem services, including definition, evaluation, and valuation, and perhaps toward issues of valuing reductions in mortality risk.

EPA's level of research in economic, decision, and behavioral sciences appears grossly inadequate to support its mission, i.e., to protect human health and the environment by developing regulations and other policies to alter behavior of individuals, firms, and other organizations. Economic, decision, and behavioral sciences that clarify how these agents respond to alternative policies, and how policies can be designed to be more effective and less burdensome, should be a central component of EPA research. EPA's past research in this area has led to major advances in policy with benefits that appear to dwarf the Agency's cumulative expenditures on this research. For example, EPA research on economic-incentive regulatory mechanisms has contributed to shifting tradable permits and similar mechanisms from politically unacceptable to a preferred choice, sharply reducing the cost of achieving environmental quality. Similarly, EPA research on methods to estimate the monetary value of reductions in health risk provide a basis for showing that regulation of fine particulate matter, despite being among the most expensive, are well-worth their cost.

b) Sustainability

Dr. Thomas Theis -

The EPA's sustainability research strategy at EPA has thus far focused on the proliferation of the sustainability paradigm throughout the other programmatic areas of the Agency. It has emerged during a transitory period from the P2 program, with a current focus on the development of meaningful metrics and indicators, support tools such as LCA, and research on innovative technologies.

One measure of the effectiveness of the strategy might be the extent to which other programs influence, and in turn are influenced by, the sustainability approach and, indeed, several (perhaps as many as 11) Agency programs have clear connections to sustainability. (One might suggest that with such a strategy the outcome of funding for sustainability would be a decline to "zero" as its mission is achieved—and looking at the one year budget trend—10%--and five year trend—down 60%--it is well on its way!).

It is, of course, ironic that at a time when environmental problems are increasingly regional and global in scope, and characterized by a high degree of complexity, that the kinds of metrics and tools envisioned within the sustainability program have not been applied within the agency and

spread to other agencies in a more systemic way. Clearly LCA methodologies are powerful ways to weigh options among competing or alternative decisions that society must make.

A new opportunity has been presented to the Agency through the new Energy Independence and Security Act of 2007, which calls for the EPA to lead the assessment of the environmental consequences of biofuels development in the US. Although this is but one of the many critical areas which will have major environmental impacts, it may represent the kind of "killer application" for the agency's sustainability metrics and support tools that will at last propel the sustainability strategy to a greater level of recognition, thus funding of this effort should be encouraged.

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4 - Clean Air and Global Change Research:

a) Global Change

Dr. Jerald Schnoor:

"In general, the Agency needs to report their strategic objectives (targets) for Global Change in terms of overall greenhouse gas emission reductions rather than solely as efficiency goals (metric tons of carbon equivalent [MMTCE] of emissions from a growing baseline). The Intergovernmental Panel on Climate Change (IPCC) 4th Assessment, a consensus of scientists, states that real emission reductions of 80% are needed by 2050, and emission reductions must begin soon. States are leading the way in these planning efforts, and for EPA to be relevant in the future, they should adopt some consistent emission reduction objectives.

"The Clean Air Program is quite successful considering its flat funding. Overall Agency FY 2009 Annual Performance Plan and Congressional Justification budget figures indicate that the President's Budget for Healthier Outdoor Air continues to delete funding of State Grants (STAG) for routine air monitoring (such as particulate matter [PM]). Such data are sorely needed for risk assessments and strategic goal assessments, and EPA should continue to fund them, or else the programs will likely be dropped by the states. Likewise, the reduction in the President's FY 2009 proposed budget for Reducing Greenhouse Gas [GHG] Intensity has cut funding for the clean car program, the GHG Registry Rule, and Energy Star by more than $9 M. These seem counterintuitive given the crisis affecting our environment from climate change and the relative cost effectiveness of these programs."

b) Clean Air (formerly NAAQS and Air Toxics)

Summary Write-Up from Rogene Henderson:

"The Air Program of EPA's Office of Research and Development (ORD) is exemplary for providing high-quality information for setting the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants and for moving the Agency in the direction of a multi-pollutant approach to the regulation of air pollutants. ORD's Air Program has expanded the scope and value of its research through leveraging the research done by other Federal agencies such as the National Institute of Environmental Health Sciences (NIEHS) and publicly- and privately-funded organizations such as the Health Effects Institute (HEI). It is essential that this core research be maintained or expanded in real (*i.e.*, adjusted for inflation) research dollars to continue this successful effort."

Jill - Air

Decreasing funding in State and Tribal Air Grants by requiring 40% matching funds from these entities will likely lead to a loss in the program because tight budgets prevail throughout the country. Limited ability for states and tribes to increase their budgets to accommodate this 40% match will mean a loss of monitoring capability which EPA needs in order to assess nationwide trends. Once the programs are eliminated at the state level, it will be difficult to fund re-start. Restoration of full funding of the STAG grants is imperative to prevent the cascading effect of federal cuts leading to state cuts, leading to irreparable loss of monitoring capability.

Indoor air is an unfunded ORD responsibility. While some of the air research, such as the research near roads can lead to indoor air mitigation in buildings housing sensitive populations such as schools, this is not a focus of the EPA's research program. Providing funding for indoor air research can be another avenue to address asthma issues.

Responsibility for mercury research may be moved into the air program, but it has extremely limited funding. Yet the concern for climate change has led to voluntary energy conservation efforts which include an increasing demand for compact fluorescent lights (CFL). These CFLs contain mercury which can be released inadvertently into homes if broken, or into waste facilities when discarded. The impact of this nationwide trend where CFLs are widely available through Walmart, Target, Ikea, and other low cost centers, coupled with consumer education programs to encourage their use for energy conservation, needs to be coupled with research on the impact on human health in indoor air as well as the impact with regard to the mercury materials balance. Life cycle analysis of these new trends is a cross-cutting issue which needs to be included in the research budget.

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5 - Technology

Attachment J
D R A F T – Do Not Quote or Cite
Preliminary Comments
SAB Conference - February 29th, 2008

a) Land Preservation

b) Nanotechnology
c) GEOSS/AMI

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

Honorable Stephen L. Johnson
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: SAB Advisory on EPA's Draft *Report on the Environment 2007: Science Report*

Dear Administrator Johnson:

EPA's Office of Research and Development requested that the Science Advisory Board (SAB) review the Agency's draft *Report on the Environment 2007: Science Report* (ROE). The ROE is an update of EPA's draft 2003 Report on the Environment which was reviewed by the SAB in 2004. In response to the Agency's advisory request, an SAB panel conducted a peer review of the draft 2007 ROE. The enclosed advisory report provides the advice and recommendations of the Panel.

The ROE is intended to present status and trend information for indicators that reflect the condition of human health and ecosystems in the United States. The SAB commends the Agency for its initiative in preparing this unique but ambitious report, and is pleased that SAB advice has been incorporated into the document. While the draft 2007 ROE represents an evolutionary advancement over the earlier 2003 version, the current draft still does not fully meet its intended purpose. Although the ROE presents status information to establish baselines for reporting future trends, the lack of long-term trend information in the document precludes trend analysis for many indicators. The ROE is also limited because it contains little data interpretation and no conclusions supported by statistical analysis. In addition, the ROE lacks a framework describing the scientific understanding of relationships between indicators and the basis for including them in the Report. The SAB has provided recommendations to improve the draft 2007 ROE and strongly recommends that they be incorporated prior to releasing the final Report. In addition, the SAB has provided recommendations to improve future Reports on the Environment with the expectation that those recommendations will require a longer time frame to implement.

The value and importance of the ROE will continue to increase as environmental pressures of population, energy use, and urbanization grow. Therefore, as recommended in its review of the 2003 ROE, the SAB again strongly urges EPA to fully support and permanently embed the ROE into its core mission-directed activities. This will require an investment of resources beyond those currently devoted to the ROE.

Thank you for the opportunity to provide advice on this important topic. The SAB looks forward to receiving your response to this advisory.

Sincerely,

Dr. M. Granger Morgan, Chair
Science Advisory Board

Dr. Deborah Swackhamer, Chair
Panel for the Review of EPA's
2007 Report on the Environment

NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board, a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to the problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use. Reports of the EPA Science Advisory Board are posted on the EPA website at http://www.epa.gov/sab.

U.S. Environmental Protection Agency
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1.0 EXECUTIVE SUMMARY

The Science Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on the Environment has reviewed the Agency's draft *Report on the Environment 2007: Science Report* (ROE 2007 Science Report or Report). The ROE 2007 Science Report compiles and reports on scientific indicators of status and trends in human health and ecological condition in the United States. EPA initially presented this information in a draft *Report on the Environment Technical Document* released in 2003 and reviewed by the SAB. Since then, EPA has revised the Report in response to feedback from the SAB and stakeholders. The ROE 2007 Science Report will be used by EPA to inform strategic planning, priority setting, and decision making across the Agency, and to communicate with the general public.

In developing the ROE 2007 Science Report, EPA compiled indicators to help answer twenty-six policy-relevant questions deemed to be critically important to the Agency's mission and national interest. EPA sought the SAB's review of: the adequacy of the formulation and scope of the questions posed in the Report; the appropriateness of the indicators in answering the questions; the accuracy of the characterization of indicator data gaps and limitations; the degree to which the data gaps and limitations of the indicators limit ability to answer the questions; the appropriateness of regionalization of national indicators; the utility of regional indicators in the Report; and the overall quality of the Report with respect to technical accuracy, clarity, and appropriateness of the level of communication. In this advisory report, the SAB provides specific comments and recommendations in response to the charge questions.

The Panel emphasizes the tremendous value of the ROE 2007 Science Report and concurs with the statement in the previous SAB review of the 2003 Report that there is an urgent need for this kind of assessment. The Report is unique in providing a comprehensive assessment of the time-varying quality of the environment including air, land, and water in relation to human and ecological health. Such an assessment becomes increasingly important as environmental pressures of population, urbanization, climate change, and energy use grow. The Panel therefore strongly urges EPA to fully support and permanently embed the Report on the Environment into its core mission-directed activities. This will require an investment in resources well beyond those currently devoted to the ROE 2007 Science Report.

The Panel finds that the ROE 2007 Science Report is a valuable collection of data and impact indicators. The Panel commends EPA for incorporating many of the SAB's recommendations from the 2004 review to improve the organization and scope of the Report. EPA has structured the ROE 2007 around questions central to the Agency's mission to protect human health and ecological condition. Generally, the SAB finds that the questions in the Report are well developed. However, a conceptual framework should be constructed and used as the basis for further developing appropriate questions. In the Report, EPA has effectively identified many of the key indicator data gaps and limitations; and regional analyses have made the Report more meaningful. However, as discussed below, the Panel has identified shortcomings in the document that limit its

usefulness in fulfilling its stated purposes. **While the Report may help inform strategic planning and priority setting, it is limited because it contains little data interpretation and no conclusions supported by statistical analysis.** Recommendations for improvements in the Report are provided in response to EPA's specific charge questions and to generally strengthen the document. The Panel provides recommendations at two levels, i.e., those to be considered before finalization of the Report, and longer-term recommendations to be considered in subsequent reports. These recommendations are listed as bullets throughout this advisory report and presented in summary tables in Appendices F and G. Additional comments and suggestions are also provided in the text of this advisory report, and detailed comments pertaining to specific indicators and technical issues are included in Appendix A.

Overarching "higher level" findings and recommendations that pertain to all chapters of the ROE 2007 Science Report

- **Strengthened scientific underpinnings:** The Panel finds that the scientific underpinnings of the final Report should be strengthened to make it a "science report," as indicated by its title, rather than simply a data report. As discussed below, this can be accomplished by including greater synthesis, interpretation, statistical analysis, and discussion related to the literature. An alternative would be to remove "science" from the title of the final Report so it is characterized as a status and trends report. When work is completed to strengthen the scientific underpinnings of future Reports, "science" could be included in the title.

- **Better integration and discussion of indicators:** The organization of the Report into individual media chapters (air, water, and land) and synthesis chapters on human health and ecosystem condition makes sense, and the approach of asking key scientific questions about the environment is a highly effective framework for organization and presentation. However, the Panel recommends that the final Report contain a greater degree of integrated discussion across the indicators and chapters than currently exists. **A conceptual framework that illustrates the connectedness between the media chapters and the human health and ecological condition chapters should be added to the introduction of the final Report. In addition we recommend that a final synthesis chapter be added to future Reports. The synthesis chapter should fully integrate the entire Report and discuss health and ecosystem status, trends, and effects from a holistic perspective.** The synthesis chapter should include a discussion that interprets the observed trends, connects the trends seen in the various indicators with cause/effect, and also connects the indicators with each other. EPA should add a brief section to the final Report outlining how a synthesis chapter could be developed in future Reports. The Panel notes that the Report provides a large amount of valuable data and information that can be interpreted by readers, but it contains few clear conclusions and statements of significance of the findings. **Future Reports on the Environment should provide such conclusions and statements.**

- **Statistics and uncertainties:** The ROE 2007 Science Report states that, due to time and resource limitations, statistical analyses of uncertainty and trends in indicators were not included. The Panel finds that this has limited the usefulness of the Report, and that a statistical approach to analysis and presentation of the data is needed to add rigor to the Report. **The Panel therefore recommends that EPA incorporate into future Reports on the Environment an approach to statistical analysis and reporting across all indicators.** This should be part of the results presentation for each indicator. In some cases, this may involve formal statistical analyses, whereas in other cases it may involve the inclusion of additional information such as error bars around mean values. When there are insufficient data available for robust quantitative analyses, such statistical limitations should be reported. Without such information, the ROE cannot fully meet its intended purpose of reporting scientifically established trends in human health and environmental condition.

- **All questions in the final Report should address status and trends:** The Panel was asked to comment on the adequacy of the formulation and scope of questions posed in the ROE 2007 Science Report. Although the scope of the questions posed in the Report is generally appropriate, questions are asked only about trends. Most of the information presented in the Report reflects indicator status rather than trends. **The Panel recommends that all questions in the final Report address both status and trends.** The discussions of "what the data show" should clearly reflect cases where trends cannot be presented because only status information is available. In addition, it is recommended that EPA explicitly state how each question is related to the conceptual framework of the Report.

- **Indicator selection criteria:** The Panel was asked to comment on whether the indicators presented were used appropriately to answer questions contained in the Report. Indicators were selected against a set of specified criteria. The Panel finds that, with some exceptions, appropriate indicators were selected. However, the rigid application of indicator selection criteria, particularly national representativeness, has resulted in the exclusion of valuable and relevant information. **As discussed in various sections of this advisory report, the Report on the Environment can be strengthened by adjusting the criteria to include additional indicators that inform the stated questions. In addition, the Panel recommends that for each indicator in the final Report, EPA provide a clear description of why the indicator is important, what it tells, and the documented relationship between the indicator and human health and ecological condition.**

- **Indicator discussion:** Each question contained in the Report is accompanied by a discussion of the most critical indicator gaps, limitations, and challenges that prevent the question from being fully answered. The Panel was asked to comment on the adequacy, objectiveness, and transparency with which the indicator gaps and limitations were characterized. In general, the Panel finds that most of the critical indicator data gaps and limitations have been identified. However, to improve the final Report, **additional clarification is required to differentiate indicator limitations from data gaps. The Panel recommends that in future Reports on the**

Environment, the discussion of indicator limitations and data gaps be distinguished. For example, the limitations could be grouped based on geographic limitations; statistical limitations; and data coverage limitations. The Panel also recommends that the indicator gaps discussion in the final Report be expanded to identify some of the more prominent available data sets that were excluded, and the reasons for their exclusion.

- **Regional indicators:** The Report has broken out national-level data for some of the indicators by EPA region, and provided ten regional indicators. The Panel was asked to comment on the utility of these approaches. The Panel finds that regional analysis of data makes the Report more meaningful. The Panel also recognizes the pragmatic appeal of using EPA administrative regions for this purpose. However, the use of EPA administrative regions to scale national data has little ecological justification and does not provide particularly informative geographic descriptors of human health. **Therefore, the Panel recommends that in future Reports on the Environment, indicator data be presented by relevant geographic units such as ecoregions, airsheds, and watersheds.** This would be a useful approach for presenting both ecological and human health data. The Panel supports the use of regional indicators that can reflect important information for gauging the state of the U.S. environment. Key regional issues such as the ecological health of the Great Lakes or the Everglades should also be addressed in a national report on the environment, and the use of state and county data could increase the resolution for reporting the health indicators in future Reports.

- **Use of regional indicators and case studies to illustrate trends:** It is disappointing that the lack of available long-term data for many indicators precludes trend analysis and limits the usefulness of the Report. **Regional data are not a substitute for national or even representative national data.** However, the Panel notes that with appropriate caveats, more regional indicators and case studies with long-term, well-supported data sets could be used in future Reports on the Environment to illustrate trends when national data sets are not available. Some regional case studies are included in the Report, and it should be clearly stated that the specific case studies presented may not be representative of a general or national situation. However, this concern should not constrain the use of additional regional studies to demonstrate important examples of national importance or particular significance to local populations. In Section 5.0 of this advisory report, the Panel suggests criteria that might be applied to identify useful regional indicators and case studies.

In addition to overarching findings and recommendations pertaining to all chapters of the ROE 2007 Science Report, the Panel has provided specific recommendations pertinent to individual chapters of the Report.

Air chapter findings and recommendations

Although the questions in the air chapter of the Report are generally appropriate, a science framework is needed to show interaction within, between and among media, as

well as between and among indicators. The Panel also notes that a short historical section should be included in the air chapter of the final Report to provide background information on the criteria pollutants. This information is needed to provide an understanding of the importance of these pollutants as indicators, how they have been tracked, and their relationship to other indicators in the Report. As discussed in Section 6.0 of this advisory report, the Panel has identified a number of missing air indicators that should be added to the final Report because they represent important trends in air quality, or present a more holistic picture of atmospheric chemistry. These include SO_2 concentration and air toxics information. The Report should also discuss key trends in the understanding of the atmosphere, such as the clear reduction of primary pollutants (CO, SO_2, and Pb) and much flatter trends in secondary pollutants (O_3 and $PM_{2.5}$).

Most of the gaps and limitations of air indicators have been appropriately identified in the Report. However, the Panel finds that the pollutant-by-pollutant recounting approach used in the air chapter does not show the interplay of the various criteria and toxic pollutants with one another or the role of stratospheric ozone depletion and climate change with respect to air quality. In addition, the pollutant information in the Report does not demonstrate the relationship to human health. An integrative description of these air pollutants is needed in the final Report to provide public or other policy makers a full picture of the state of the atmospheric environment.

Water chapter findings and recommendations

The Panel finds that some of the questions in the water chapter inappropriately call for information on trends in both the extent and condition of certain indicators. Therefore, it is recommended that in the final Report, EPA refine the differentiation between extent and condition for indicators where inclusion of both extent and condition measures does not make sense. For example, it is not meaningful to refer to the extent of coastal waters because the issue of importance is condition. In addition, questions should be incorporated into the water chapters of future Reports on the Environment to provide information on critical habitats and missing thematic elements such as trends in water availability and usage of water for human activities.

The Panel finds a lack of acceptable water indicators in the Report to answer some of the questions posed. The following additional types of indicators are recommended to answer questions in future Reports on the Environment. 1) The freshwater indicators in the Report have a strong lotic bias and equal attention should be devoted to indicators relevant to lentic systems. 2) EPA should identify and use indicators that have relevance to human health as well as to ecology. The Panel notes that in the Report, concentrations of chemical indicators have been inappropriately compared to drinking water maximum contaminant levels. 3) EPA should identify indicators of important ecosystem processes such as denitrification, decomposition, and primary production. In this regard, data on biogeochemical processes in wetlands such as organic matter decomposition and accretion, denitrification, and sulfate reduction can provide early indications of impending ecological changes. 4) EPA should identify indicators that will aid in evaluating the impact of emerging issues such as biofuel feedstock production on the

quality and quantity of water. 5) Some chemical indicators, such as pesticides in agricultural streams, should be based on measured concentrations in sediments and biota, if available, rather than the water column where concentrations may be low but biota may be impacted by elevated levels in sediments.

Land chapter findings and recommendations

The questions in the land chapter address land resource management and land contamination. The questions are appropriate although somewhat peripheral to EPA's mission. It is recommended that in future Reports on the Environment EPA consider adding a question that addresses the important issue of soil quality and conservation. In future Reports on the Environment EPA should also: 1) consider a range of available land cover classification schemes with different levels of resolution (this is necessary because the resolution of the data in the current draft of the Report is too coarse to completely answer the questions); 2) extend land cover characterization to all major ecosystem types, not just the forest land characterized in the current draft of the Report; and 3) adopt standard approaches for land use and land cover analysis to evaluate information and document trends across a range of available data sets. Moreover, as further discussed in Section 8.0 of this advisory report, the Panel finds that the questions in the land chapter are not completely answered by the indicators presented, and the range of indicators in the land chapter is not at the same overall level of development as in the water and air chapters. For example, few land indicators provide direct measures of effects on human health. Some additional resources and an expanded set of disciplines are needed to bring the land chapter to the level of evaluation provided in other chapters. To more completely answer the questions posed in the land chapter, the Panel recommends that EPA include the following additional indicators in the final Report:1) a pesticide use indicator (this would be particularly important from the standpoint of human exposure); and 2) indicator data for persistent bioaccumlative toxics (PBTs) and mining wastes (e.g., Toxics Release Inventory derived information), radioactive wastes, and wastes applied on agricultural land (biosolids, compost, etc.)

Human health chapter findings and recommendations

The questions in the human health chapter are comprehensive, appropriate, and well-developed. However, the Panel notes that they encompass both human health and exposure. It is therefore recommended that in the final Report, the chapter be more descriptively renamed "Human Exposures and Health." The indicators used in the human health chapter are appropriate, but the Panel recommends that in future Reports on the Environment, EPA consider using an expanded suite of human health indicators that include National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS) information (Centers for Disease Control and Prevention, 2008a,b), hospital and emergency room admission data (if publicly available), and reports of infectious disease maintained by the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2007). These indicators would more effectively capture important health concerns such as effects related to indoor air quality, use of pesticides, and exposure to pathogens.

In addition, the Panel finds that there is a critical need to expand the indicator discussion in the final Report to address indicator relevance to the stated questions. Such discussion is needed because the relevance of the indicators to the questions can be wide ranging and it is important that the Report provide a characterization of the value or importance of the indicator to the question. Strong epidemiologic evidence is available in the literature to support many of the indicators EPA has chosen (i.e., cancer incidence, childhood cancer incidence, cardiovascular disease, chronic obstructive pulmonary disease, asthma, infectious disease, birth defects, low birth weight, and preterm delivery) and it is recommended that a qualitative or quantitative description of such information be provided in the final Report. To further strengthen the scientific credibility of the Report, the Panel recommends that the discussion of indicator gaps and limitations also be expanded in the final Report to include a more quantitative description of indicator relevance by relying on the epidemiologic literature. The discussion might be further expanded to address how the limitations and gaps affect the interpretations of the indicators.

Ecological condition chapter findings and recommendations

The questions posed in the ecological condition chapter of the Report are generally appropriate but the Panel recommends that in the final Report, the chapter be reorganized to reflect an integrated focus on ecosystem health. Some revision of the questions may be needed as the chapter is reorganized. It is recommended that the chapter be organized hierarchically according to: 1) major ecosystem type, 2) ecosystem processes and services, and 3) ecosystem components (physical, chemical, biological). In addition, the Panel finds that the scope of indicators in the ecological condition chapter needs considerable broadening to cover all ecosystem types and fill specific gaps (i.e., missing ecosystems, missing populations, and missing processes) in the indicator coverage. Specific indicators and indicator types have been suggested in Section 10.0 and Appendix A of this advisory report to broaden the coverage and fill gaps. Easily accessible data may be available for some of these indicators and they could be included in the final Report, while others should be included in future Reports on the Environment. It is recognized that EPA cannot develop an unlimited set of indicators but should select those that address key ecological issues.

2.0 INTRODUCTION

This report transmits the advice of the U.S. Environmental Protection Agency Science Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on the Environment. The Panel conducted a peer review of EPA's draft *Report on the Environment 2007: Science Report* (ROE 2007 Science Report or Report). The draft ROE 2007 Science Report compiles and updates scientific indicators of status and trends in human health and ecological condition in the United States. EPA released its first draft Report on the Environment in 2003. That report was reviewed by the SAB (U.S. EPA Science Advisory Board, 2004) and the SAB's advice was used to develop the improved and updated ROE 2007 Science Report. A second SAB Panel was formed to review the 2007 Report. EPA intends to use the ROE 2007 Science Report to inform strategic planning, priority setting, and decision making across the Agency. The ROE 2007 Science Report is also intended to provide information that will enable the public to assess whether EPA is succeeding in its overall mission to protect human health and the environment.

In developing the ROE 2007 Science Report, EPA identified twenty-six policy-relevant questions about environmental and human health deemed to be critically important to the Agency's mission and national interest. The Agency selected a suite of indicators to answer these questions. The ROE 2007 Science Report consists of chapters developed to answer status and trend questions concerning air, water, land, human health, and ecological condition. In each of these five chapters, EPA: described the scope of the priority questions to be answered; provided a set of indicators to answer the questions; and discussed indicator data gaps, limitations, and challenges that prevented questions from being fully answered. In the ROE 2007 Science Report, EPA established an explicit indicator definition and six indicator criteria. The Report presents indicator status information to establish baselines for reporting future trends but it does not provide long-term trend information for many indicators. EPA stated that the ROE 2007 Science Report was written for a target audience of environmental professionals. The Agency developed a less detailed ROE 2007 "Highlights Document" for the more general audience of concerned citizens, and a web-based "e-ROE" to facilitate electronic access to materials in the Report and provide timely updates in the future. The SAB Panel was asked to review only the ROE 2007 Science Report.

The Panel emphasizes the tremendous value of EPA's Report on the Environment. This is a unique report with the objective of providing an assessment of changes in environmental quality over time as related to human and ecological health. We concur with the statement in the SAB's review of EPA's draft 2003 Report that there is an urgent need for this kind of assessment. It can have an important impact on improving the state of the environment by synthesizing relevant information from many sources for the development of effective environmental monitoring, policy, and protection programs. EPA's Report on the Environment can also provide the public with essential information about environmental status and trends and their relevance to public health and ecological condition**. The Panel therefore strongly urges EPA to fully support and permanently embed the Report on the Environment in its core mission-directed activities.** This will require an investment in resources beyond those currently devoted to

the ROE 2007 Science Report. The EPA staff that produced the ROE 2007 Science Report are commended for their remarkable productivity and output; however, a sustained and increased investment in staff and expertise for the Report on the Environment is essential and strongly recommended. The Panel offers recommendations for improvements in the ROE 2007 Science Report to make it more useful to EPA and other intended audiences.

3.0 CHARGE TO THE REVIEW PANEL

EPA gave the following six charge questions to the SAB Panel for its review of the ROE 2007 Science Report.

Charge Question 1. Please comment on the adequacy of the formulation and scope of the questions in the Chapters of the *Report on the Environment 2007: Science Report*. Does the SAB have any specific recommendations on how to improve or clarify the formulation of the questions? Does the SAB have recommendations on changing the scope of the questions to better reflect EPA's mission?

Charge Question 2. Please comment on whether all of the relevant indicators in the Report have been used appropriately to answer the questions. Please comment on whether the integrity of the material in the indicator write-up is preserved in the chapter narrative.

Charge Question 3. Please comment on the adequacy, objectivity, and transparency of the identification and communication of gaps and limitations of the indicators in answering the Report on the Environment questions.

Charge Question 4. Please comment on the utility, comparability, and objectivity of the regionalization of the national Report on the Environment indicators. Does the use of EPA Regions to scale national data accurately reflect, or does it inappropriately distort, the problem domain?

Charge Question 5. Please comment on the utility of the regional indicators in *Report on the Environment 2007: Science Report* in answering the questions. Does the SAB have recommendations for whether and how to build on this base in future versions of the report?

Charge Question 6. Please comment on the overall quality of the *Report on the Environment 2007: Science Report* with respect to technical accuracy, clarity, and appropriateness of the level of communication.

4.0 REVIEW PROCESS

The Panel's review of EPA's ROE 2007 Science Report was structured to develop responses to all of the charge questions for each chapter of the Report. Panel subgroups were assigned lead responsibility for reviewing individual chapters of the Agency's draft Report. The Panel then discussed the subgroup responses and developed specific findings and recommendations concerning the air, water, land, human health, and ecological condition chapters. The Panel has also provided "higher level" overarching recommendations that pertain to all chapters of the ROE 2007 Science Report. The overarching findings and recommendations in Section 5.0 of this advisory report address EPA's specific charge questions as well as general improvements needed to make the ROE 2007 Science Report a more effective assessment of status and trends in human health and ecological condition. The Panel has recommended revisions that should be incorporated into the final Report as well as improvements that will require a much longer time frame to implement, and thus should be incorporated in future Reports on the Environment. These recommendations are listed as bullets throughout this advisory report and presented in summary tables in Appendices F and G. Additional comments and suggestions are also provided in the text of this advisory report, and detailed comments pertaining to specific indicators and technical issues are included in Appendix A. The Panel strongly recommends that EPA make the suggested near-term changes prior to releasing the final Report.

5.0 OVERARCHING RECOMMENDATIONS

The Panel finds that the ROE 2007 Science Report is a valuable collection of data and impact indicators, and strongly endorses continued development and dissemination of the Report. The Panel finds that the Report is an improvement over EPA's draft 2003 Report on the Environment, and commends the Agency for addressing many of the SAB's comments and recommendations on the 2003 Report. As recommended by the 2004 SAB Review Panel, the ROE 2007 is free from conclusions about the impacts of specific policies or government initiatives, regional indicators have been incorporated into the Report, and some key missing indicators have been added. The 2007 SAB Review Panel notes, however, that some recommendations of the previous SAB review panel were not addressed. Additional funds and personnel have not been allocated to sustain development of the Report on a continuing basis, and analyses of greater statistical rigor have not been included in the Report. Generally, the formulation and scope of the questions in the ROE 2007 Science Report are adequate, narratives in the text have captured information about the indicators presented in the document, EPA has effectively identified many of the key indicator data gaps and limitations, and regional analyses have made the Report more meaningful. However, as discussed below, the Panel has identified numerous shortcomings in the document that limit its usefulness in fulfilling its stated purposes. While the Report may help inform strategic planning and priority setting, it is limited because it contains data with little interpretation and no conclusions supported by statistical analysis. Recommendations for improvements in the Report are provided to make it more useful to EPA and other intended audiences.

Organization of the ROE 2007 Science Report

The organization of the Report into individual media chapters (air, water, and land) and synthesis chapters on human health and ecological condition makes sense, and the approach of asking key scientific questions is a highly effective framework for presenting the information in the Report. However, the Panel finds that the introduction of the Report should be revised to clearly articulate EPA's objectives in developing the document and to more fully describe the structure of the document. As further discussed below, the introduction should also provide a conceptual framework that illustrates the connectedness between the media, human health, and ecological condition chapters. To articulate EPA's objectives and describe the structure of the Report, the Panel recommends the following changes in the introduction:

- **In the final Report, the introduction should be revised to clearly indicate that the first three chapters address status and trends using specific indicators for the individual "media" of air, water, and land, and that the next two chapters are syntheses that provide integrated assessments of status and trends in human health and ecosystem condition.**

- **In the final Report, the introduction should also clearly state its purpose for intended audiences and EPA. The introduction should discuss how the Agency plans to use the Report and its analyses, and how the Agency wants the Report to be used by the broader public. In this regard, the final Report should state that it provides status information to establish baselines for reporting future trends, but does not include long-term trend information for many indicators.**

Strengthened scientific underpinnings

The Panel finds that the scientific underpinnings of the final Report should to be strengthened to make it a "science report," as indicated by its title, rather than simply a data report. As discussed below, this can be accomplished by including greater synthesis, interpretation, statistical analysis, and discussion related to the literature. An alternative would be to remove "science" from the title so that the report is characterized as a status and trends report. If work is completed to strengthen the scientific underpinnings of subsequent versions of the Report, "science" could again be included in the title.

Incorporation of a conceptual framework and synthesis chapter

The Panel finds that the final Report needs a greater degree of integrated discussion across the indicators and chapters. Each chapter of the Report is currently designed to be a stand-alone document for readers interested in the particular subject areas of land, water, air, health, and ecology. Consequently, the interconnections among these areas are not well established or discussed. For example, the relationship between waste management and chemical uses (addressed in Chapter 4) and water quality (addressed in Chapter 3) is mentioned in the introduction of the water chapter, but this relationship is not obvious from the presentations of the individual indicator data. In addition, the possible links between greenhouse gas emissions (in Chapter 2) and global sea level and temperature changes (in Chapter 6) are not discussed. The Report currently contains a

discussion section after each question and related series of indicators, but there is not a corresponding synthesis discussion across the questions to tie the document together and make the whole greater than the sum of its parts. The Panel also notes that, although the Report provides a large amount of valuable data and information that can be interpreted by readers, it contains few clear conclusions and statements of significance of the findings. In future Reports on the Environment, EPA should provide such conclusions and statements. The Panel specifically recommends that:

- **In the final Report, EPA should incorporate a conceptual framework into the introduction to illustrate the connectedness between the media, human health, and ecological condition chapters**. The conceptual framework could be a short but comprehensive description and figure that demonstrates scientific understanding of the relationships between the stressors (drivers), responses, and outcomes to human health and ecosystem condition. An example conceptual framework figure is provided in Appendix C of this advisory report. The conceptual framework should address relationships between source, transport, and fate of human and environmental health hazards, as well as exposure to receptors, dose, and impact. The description of the conceptual framework might discuss efforts underway to develop so-called linked indicators of environmental hazards and human health, such as the Environmental Public Health Tracking Project (National Association of County and City Health Officials, 2007). The figure could be included in the introduction with appropriate similar figures at the beginning of each chapter to provide overall context for the chapter and illustrate how the chapters are connected. For example, in each chapter the relevant parts of the figure that show the role and importance of a given chapter could be highlighted in the graphic. This would provide the clear basis for the use and prioritization of specific indicators, the choice of scale and boundaries in regional indicators, and selection of metrics (i.e., thresholds, benchmarks, etc.) The choice in scale and metrics would provide the appropriate context for future monitoring and assessment of status and trends.

- **In future Reports on the Environment, a synthesis chapter should be included to fully integrate the Reports and provide an overall assessment of health and ecosystem status, trends and effects.** The synthesis chapter in future reports could also analyze and discuss in more detail the connections among various related indicators as well as relationships among the media and health and ecology chapters. For example, the relationship between nitrogen and phosphorus in agricultural watersheds (in Chapter 3) and fertilizer use (in Chapter 4) could be discussed. In this regard, a number of questions could be addressed, such as: Is there any evidence that indicators are correlated? Is it possible to use the indicator data for such an analysis? EPA should add a brief section to the final Report outlining how a synthesis chapter could be developed in future Reports.

- **In appropriate places in the final Report, interconnections between the indicators should be established by cross-referencing the discussion of indicators in different chapters.** EPA should elaborate wherever possible on the relationships

between indicators and the outcomes with respect to human health and ecological condition.

- **In future Reports on the Environment, a summary section should be included after each media chapter to summarize information presented in the chapter and identify relevant emerging issues that could potentially affect human health and the environment.**

Statistical analysis

The ROE 2007 Science Report states that, due to time and resource limitations, statistical analysis of uncertainty and trends in indicators was not included. The Panel finds that this has limited the usefulness of the Report, and that a statistical approach to analysis and presentation of the data is needed. Without such information, the Report on the Environment cannot fully meet its intended purpose of reporting scientifically established trends in human health and environmental condition. The Panel understands that EPA has begun this work for some indicators and that the analysis for those indicators will be included in the final Report. It is our further understanding that this work will eventually be completed for all indicators. The Panel understands that some of the most important indicators are not well developed and few high quality data sets may be available for these indicators. The Panel suggests that these indicators could be used with the explanation that a higher level of statistical analysis and reporting will be developed in the future. We encourage the effort to develop statistically established trends and recommend that:

- **In future Reports on the Environment, EPA should incorporate statistical analysis and interpretation in the reporting of all indicators.** This should be part of the results presentation for each indicator. In some cases, this may involve formal statistical analyses, whereas in other cases it may involve the inclusion of additional information such as error bars around mean values. The Panel notes that this approach should be developed taking into consideration the need for statistical accuracy as well as the importance of using available information to report on indicators of human health and environmental condition.

Charge Question 1. Adequacy of formulation and scope of questions in the ROE 2007 Science Report

The Panel was asked to comment on the adequacy of the formulation and scope of questions posed in the ROE 2007 Science Report. The Panel notes that in the ROE questions are asked only about trends. The scope of the questions should be broadened in the final Report to focus on status as well as trends. This will reflect the importance of capturing information to represent a baseline established as an initial step to evaluate trends when more data become available. To help readers understand the importance of the questions and associated indicators, it is also important to explain the relationship between the questions and the conceptual framework in the final Report. The Panel therefore recommends that:

- **In the final Report, all questions should be broadened to ask, "What are the status and trends…" rather than focusing only on trends.** In some chapters of the Report a few long-term data sets are presented. However, the information in the Report is focused more on status than trends. The questions should therefore address both status and trends. In cases where a trend cannot be presented because only status information is available, this should be clearly reflected in the discussion of what the data show.

- **In the final Report, EPA should explicitly state how each question in the Report is related to a conceptual framework.** The Panel recognizes that in the Report EPA has included "policy relevant" questions that are important to the Agency's program offices. However, the conceptual framework should be constructed, and appropriate questions should follow from the framework.

Charge Question 2. Use of indicators to answer questions in the ROE 2007 Science Report and presentation of indicator data in the chapter narratives

The Panel was asked to comment on whether the indicators presented in the ROE 2007 Science Report were used appropriately to answer questions in the Report, and whether narratives in the text accurately captured indicator information. The Panel has responded to this question and has also identified a number of missing but appropriate indicators (discussed in Sections 6.0 – 10.0 and Appendix A of this advisory report). In particular, as discussed in Section 10.0 below, indicators should be included in the final Report to represent the status of and trends in ecosystem services. In addition, the Panel recommends that the final Report contain further discussion of the relationships between the indicators and human health and ecological condition.

EPA established a set of criteria that were used to drive the process of selecting the indicators in the Report. The criteria included rigorous data requirements for selection of indicators. The Panel finds that, with some exceptions, the narratives in the text of the Report have accurately captured the indicator data. However, the high data standards established by the indicator selection criteria are restrictive and this has resulted in the exclusion of many important indicators of status and trends in human and ecological health. As further discussed in other sections of this advisory report, future Reports on the Environment can be strengthened by including indicators and data sets that may not meet the current selection criteria. The Panel specifically recommends the following:

- **In the final Report, EPA should provide a clear description of why each indicator is important, the rationale for selecting the indicator, what it tells, and the documented relationship between the indicator and human health and ecological condition. An example indicator description is provided in Appendix C of this advisory report.** For each indicator, the description could be provided in an introductory section that refers to the conceptual model or framework. This is critical in order to enable the reader to interpret the meaning of the indicator relative to the question. The primary stressors (e.g., air emissions data) are important

indicators but the Report should more fully explain how these stressors contribute to answering questions in the Report.

- **In the final Report, additional indicators (identified in various sections of this advisory report) should be included to show the response of more integrated components of the system or address missing issues. For example indicators should be included to capture the status of and trends in ecosystem services**. For information on this topic, EPA is referred to Meyerson et al., 2005. Ecosystem services classification and indicators are further discussed in Section 10.0 of this advisory report.

- **In future Reports on the Environment, the indicators selected should be clearly related to the "big picture" fundamental questions, and not chosen just because of data availability or compliance with indicator criteria (i.e., they are the only indicators left after others have been eliminated).**

- **In future Reports on the Environment, EPA should consider relaxing the restrictive indicator selection criteria so that additional indicators can be included.** This will enable EPA to better evaluate trends and answer questions in the Report. In this regard, regional indicators supported by long-term data sets may be particularly useful. The Panel appreciates that EPA's indicator selectivity is in response to the 2004 SAB review, but the Panel feels the selection criteria have been made too restrictive and rigid such that useful data have been excluded. One way to revise the selection criteria in order to identify useful regional indicators and data sets would be to classify indicators according to completeness or rigor. This could supplement the current approach of classifying the data as national or regional. For example, indicators could be classified as high, medium, or low with respect to confidence in the ability to detect trends based on data continuity. Although this is recommended as a revision for future Reports on the Environment, some regional trend data may currently be available and easily obtained. In these cases, revision of the final Report is recommended to use the available data. Additional specific indicators that should be considered are identified in various sections of this advisory report. For example, a coral reef indicator and National Oceanographic and Atmospheric Administration status and trends data could be included if restrictive selection criteria were relaxed.

  The Panel recognizes that it is not a simple task to change the indicator selection criteria to take into account the importance of additional long-term data sets and key indicators in various media and systems. However, the conceptual framework of the Report should drive the design of criteria that will enable selection of the best indicators to answer questions posed in the Report.

- **In the final Report, additional trend data (classified as either qualitative or quantitative) should be included for as many indicators as possible.** This is recommended as a revision for the final Report if data are available and certainly as a revision for future Reports on the Environment.

- **In the final Report, EPA should identify the status of the monitoring programs (e.g., extant, "on hold," or expired) that have provided indicator data used in the Report.** This will enable readers to determine whether additional trend information will be available in the future.

Charge Question 3. Discussion of indicator data gaps and limitations in the ROE 2007 Science Report

Each question in the ROE 2007 Science Report is accompanied by a discussion of the most critical indicator gaps, limitations, and challenges that prevent the question from being fully answered. The Panel was asked to comment on the accuracy of characterization of the indicator gaps and limitations, and the degree to which they limit the ability to answer questions in the Report. In general, the Panel finds that most of the critical indicator data gaps and limitations have been identified and clearly explained in the Report. However, the Panel is troubled by the frequency of statements indicating that long-term data were not available for many indicators, and that this precluded trend analysis. The Panel appreciates this transparency but finds that there are too many indicators in the ROE 2007 Science Report that use "snapshot" data. The Panel acknowledges that baseline data are essential but, as noted above, in future Reports on the Environment EPA should consider relaxing the indicator criteria, especially on a regional basis, to allow the use of data sets that are amenable to trend analysis.

It is somewhat problematic that many of the indicators in the Report aggregate data over a prolonged period of time. While this may be the result of the sampling methodology, it should be mentioned and discussed as a weakness. For example, in the presentation of the indicator "nitrogen and phosphorus in streams in agricultural watersheds," the data are aggregated over nearly 10 years, but it is safe to assume that agricultural practices and land cover in each of the watersheds have changed over that time. The Panel notes that these changes in agricultural practice may be a confounding effect.

The Panel also notes that it is not always clear which bullets in the Report refer to "indicator limitations" or to "data gaps." This should be clarified in the final Report, and in future Reports on the Environment it may be useful to subdivide the data gaps and limitations section into different types of limitations instead of providing a laundry list after each indicator. For example, the limitations could be grouped based on: 1) geographic limitations; 2) statistical limitations; 3) data coverage limitations; etc. The following specific recommendations are provided to amplify and clarify the discussion of indicator data gaps and limitations in the Report:

- **In the final Report, EPA should clarify whether specific bullets in the indicator limitations sections refer to indicator limitations or data gaps.**

- **In future Reports on the Environment, each of the sections that address data gaps and limitations should be separated into clear discussions of types of limitations (e.g., geographic, statistical, data coverage, etc.)**

- **In the final Report, the discussion of gaps and limitations should be expanded to identify some of the more prominent available data sets that were excluded and the reasons for their exclusion (e.g., technical concerns, lack of statistical power, or other specific reasons).** This discussion should refer to the indicator selection criteria and might identify indicators that could effectively narrow data gaps but may not meet specific stringent criteria (e.g., older data sets that can be used to show trends in important indicators, regional data sets that are of national interest or case studies demonstrating a framework for discussion or national applicability). This would help address questions about some omissions, such as fish advisories issued by states and birth defect data.

- **In the final Report, the discussion of data gaps and limitations should be strengthened by adding or expanding existing information in several areas.** These include: 1) discussion of the need for a transparent set of indicator metrics that can be well justified (the current choices of metrics and benchmarks are not well justified); 2) the need to provide additional information at the end of each individual chapter on emerging issues such as chemicals of emerging concern, exotic wildlife diseases or invasive species (the Panel specifically notes that perfluorinated chemicals should be added to the list of emerging contaminants of importance in Chapter 7 of the ROE 2007); and 3) further justification and discussion of limitations associated with the intervals of time used to establish trends. To understand and account for such potential confounding effects, the description of each indicator should include a discussion of the relevant time periods that can be aggregated without losing integrity.

- **In the final Report, the implications of each indicator limitation should be discussed, and the uncertainties associated with each limitation should be quantified to the extent feasible.** One possible approach to address uncertainty would be to assign a level of confidence to the inferences that can be drawn from the data sets. Even a subjective evaluation would provide helpful information.

Charge Question 4. Regionalization of national indicators in the ROE 2007 Science Report

The ROE 2007 Science Report has broken out national-level data for some of the indicators by EPA region, and the Panel was asked to comment on the utility of this approach. The panel notes that national-level indicators are by themselves insufficient for gauging the state of the U.S. environment. Nationally aggregated data cannot reflect local and regional environmental trends that are important to the quality of life and health of the residents living in these areas. Exposures to environmental contaminants may be relevant at three scales: national (e.g., mercury emissions), regional (e.g., contaminants in lake fish), and local (e.g., contaminated land sites). Moreover, disasters such as

Hurricane Katrina and "9/11" taught us that while the immediate direct effects of such events are regional or local in scale, the overall long-term effects reverberate through the nation. Similarly, a decline in the health of one region's environment could affect the entire nation. Therefore, national indicator data should be presented at the finest spatial resolution that can be scientifically supported. For example, it would be valuable to examine national trends in air quality as well as regional, state, and/or county trends.

The disaggregation of the national indicator data in the Report by EPA administrative regions is useful for some purposes. For example, indicator data for individual EPA regions could be used for goal setting and performance evaluation. However, this should be done independently from the primary environmental assessments because the use of EPA administrative regions to scale national data has little ecological justification and does not provide particularly informative geographic descriptors of human health. Appendix D of this advisory report provides further discussion of how ecoregionally derived indicator information could be used for action and decision making by EPA regional offices. The Panel finds that a preferable approach would be to analyze the air, water, land, human health, and ecological condition indicators using appropriate airshed, watershed, and ecoregional units. A useful approach to regionalization of indicators may be to include two subcomponents for each indicator: 1) a national metric of some kind, with the obvious caveat that data aggregation can lead to masking of local trends; and 2) a consistent (whenever possible) approach to showing regional data, preferably based on ecologically justifiable regions, not EPA administrative regions. The following specific recommendations are provided regarding this approach.

- **In future Reports on the Environment, EPA should analyze the air, water, land, human health, and ecological condition indicators using appropriate airshed, watershed, and ecoregional units.** However, the appropriate scaling for indicator analysis and reporting must be considered on an indicator-by-indicator basis. This is true also for temporal scaling issues and the appropriateness of data aggregation over time and space.

- **In the final Report, if EPA administrative regions continue to be used as the basis for regionalizing data, the Panel recommends that this process be better explained.** For example, it is unclear why the data are not presented consistently for each Region. Presenting these data consistently for each EPA Region would at least provide more comparability, although it will not address the bigger issue of ecological validity. The strengths and limitations of using EPA administrative regions to regionalize data should also be discussed.

Charge Question 5. Utility of regional indicators in the ROE 2007 Science Report

EPA has included ten regional indicators in the ROE 2007 Science Report. The Panel was asked to comment on the utility of regional indicators in answering the questions in the Report. The Panel finds that regional indicators and case studies should be used in future Reports on the Environment when they may be of particular value for use in trend analysis, or provide information that is vital to the nation's interest (e.g., topsoil

preservation in the central Midwest). Examples will be most valuable if they can be replicated across the U.S. In addition, important regional issues, such as the ecological health of the Great Lakes or the Everglades, should be addressed in a national report on the environment. The Panel notes, however, that the justification for the inclusion of particular regional indicators is not clear in the current draft of the Report on the Environment and therefore appears somewhat arbitrary. It is difficult to understand why the current regional indicators have been chosen, as they do not appear to provide value for replication elsewhere.

The Panel finds that the use of regional examples is particularly useful in cases where:

- They present the successful application of an approach, model or tool that may have wider application. For example, the conceptual approach used for Biscayne Bay may have application to a wide range of problems in quite different environments, and the connectivity done for EPA Region 4 may have broader applications.
- They serve to explain the functioning of the ecosystem and help build understanding of a conceptual framework of wider application. Diagrams of conceptual models or frameworks might be linked (especially in the web version of the "e-ROE") to regional examples that demonstrate processes or cause and effect relationships.
- They have wider applicability to areas within the same ecologically relevant region or type. Case examples can be very effective if the Report is built around natural systems (for example, tidal wetlands, dunes, tundra).
- They have long-term data sets that permit explanation of trends. This would be especially useful where nationwide data sets have limited time series.
- They represent an issue of national importance and deserve illumination even if they fail to meet the other criteria. Significance may stem from its natural resource value (e.g., Great Lakes), or from its importance as an emerging issue (nanotechnology, pharmaceuticals).
- They provide a higher resolution example of a nationwide indicator.

The following specific recommendations are provided concerning the use of regional data sets and indicators:

- **In future Reports on the Environment, it is recommended that EPA identify and use, with appropriate caveats, more regional indicators and data bases to illustrate trends when national data sets are not available**. The Panel notes, however, that such regional data are not a substitute for national or even representative national data and can be misleading if not carefully presented. Regional indicators should also be used in future Reports on the Environment when they have national importance or are of particular significance to local populations. Long-term, well-supported data sets are available for such regional indicators. Examples include data available from: the National Science Foundation's Long-term Ecological Research Program sites, U.S. Geological Survey (USGS) groundwater

basins, state agencies, and data collected on Lake Tahoe, Lake Mendota, and the Great Lakes.

- **In future Reports on the Environment, it is recommended that EPA develop clear and transparent criteria that are uniformly used for the selection of regional indicators and case studies, with the recognition that not all data will meet the criteria for these regional indicators.** For example, regional indicators should have long-term well supported data sets, be of particular national or local significance, or represent an assessment approach that that could be replicated.

6.0 AIR CHAPTER COMMENTS

Charge Question 1. Adequacy of formulation and scope of questions in the air chapter

In general, the Panel finds that the scope of questions in the air chapter of the Report is appropriate. However, it is problematic that the indicator data in the chapter are presented in isolation. A science framework consisting of a process model and discussion is needed in the final Report to provide context for the components by showing the interaction within, between, and among media and indicators as well as the effects on human health and ecosystem condition. The lack of such a framework is a significant problem. It is critically important for EPA to understand that data presented in isolation are not science. It is only when the data are explained as well as appropriately interrelated across factors and chapters that one gains the scientific understanding of what the data mean. The following recommendations are provided to improve the formulation and scope of the questions in the air chapter.

- **In future Reports on the Environment, the discussion provided in the response to the indoor air quality question should be expanded.** The Panel finds that the discussion of indoor air and related indicators is too limited considering the importance of the indoor environment and the amount of time spent by the population indoors. While indoor environments do not fall within the statutory mandate of EPA, exclusion of available and relevant data makes the Report incomplete. Because of the importance of consumer products (e.g. solvents, paints, glues, and building materials) as a determinant of indoor air quality and exposure, we encourage EPA to consider whether there are appropriate consumer product data available that satisfy the criteria for uses as an indicator. For example, data regarding changes in the benzene content of gasoline, paints, and varnishes with time would provide a powerful indicator of human exposure. Similarly, data concerning changes in formaldehyde content of particle board and other building materials would be relevant and informative of indoor air quality and human exposure.

Charge Question 2. Use of indicators to answer questions in the air chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative

Overall, the Panel finds that the integrity of the indicator information is maintained in the air chapter narrative, but as noted above, the indicators are not adequately linked to information across the various other Report chapters. A short historical section containing background information on the criteria pollutants is needed in the final Report to provide an understanding of the importance of these pollutants as indicators, how they have been tracked, and their relationship to other indicators in the Report. Because the Report contains no history of the air indicators, there is no indication of how long the air monitoring networks have been in place. This knowledge would give the reader a sense of the importance that EPA places on the air monitoring networks. Further, it would provide the opportunity for the reader to learn about the various types of air monitoring networks. The air chapter then can have a discussion of questions that integrate across the pollutants. In addition, it is important to discuss issues such as trends in climate (e.g., increased radiation from stratospheric ozone depletion) that likely lead to secondary pollutant problems. There is a clear need to look at the air chapter from the whole atmosphere perspective instead of simply isolated atmospheric components.

The most significant shortcoming in the air chapter is the fact that the pollutant-by-pollutant recounting approach does not show the interplay of the various criteria and toxic pollutants with one another or the role of stratospheric ozone depletion and climate change on air quality. Put another way, a holistic picture of the chemistry of the atmosphere is missing. The Panel notes that substantial gains have been made in limiting the emissions of specific primary pollutants and it is increasingly recognized that the interplay among multiple air pollutants (i.e., air pollutant mixtures) is largely responsible for the human health impacts of air pollution. Human activities have made the atmosphere more oxidizing through increases in NO_x emissions. This leads to greater ozone, more rapid conversion of SO_2 to SO_4^{-2}, NO_x to NO_3^-, and biogenic and anthropogenic volatile organic compounds (VOCs) to secondary organic aerosols. Thus, one cannot really look at the problem of ozone and fine particulate matter without considering SO_2 and NO_x emissions all together. NO_x has been controlled to the point where it does not have direct health impacts (the basis for the level in the NO_2 primary national ambient air quality standards [NAAQS]), but that approach fails to achieve control of O_3 and $PM_{2.5}$ (Particulate Matter less than 2.5 micrometers in diameter). The discussion of VOCs in the air chapter is almost entirely focused on anthropogenic VOCs, but it is now recognized that for many parts of the U.S., biogenic VOCs dominate and it is necessary to think very differently about how to bring about continuing improvements in air quality. Thus, the pollutant-by-pollutant evaluation or "stove piping" within the air chapter does not really provide a clear picture of the current status of air quality and what must be done in the future to continue the gains made over the past 35 years. Local sources no longer contribute to local concentrations that can be dealt with locally. Those sources have been or are being controlled through either air quality state implementation plan (SIPs) processes or maximum achievable control technology (MACT) and residual risk. New conceptualization of the problems is needed. Recitation of pollutant-by-pollutant gains without a truly integrative description of their interplay fails to provide the public or other policy makers of the full picture of the state of the atmospheric environment.

The Panel notes that the Report contains some discussion of trends in air indicators, but it is unfortunate that there is neither mention nor discussion of the possible direction of trends in air indicators 10 to 20 years into the future. The Agency should discuss ongoing efforts, activities and/or programs that can be qualitatively described to make the point that future trends are not static, and that processes are in place that will lead to ever-improving air quality. This would provide the reader with the rationale for the suggestion that improving air indicator trends will continue into the future. It must be made clear to the reader that EPA views air quality management as an ongoing process. The Panel also notes that EPA used data from sites going back to 1990 to demonstrate declining trends, but it is not clear that the same data for these sites during the past 5 years would provide the same understanding of trends. The issue of base year and site selection bias must be considered and a transparent description of the analysis must be provided. In addition, the Panel notes that when regional indicators are considered the picture of air quality may change. It is important for EPA to consider whether all of the available relevant information is being used in the Report.

A number of missing air indicators have been identified below and in Appendix A of this advisory report. These indicators should be added to the future Reports on the Environment because they represent important trends in air quality, or present a more holistic picture of atmospheric chemistry. The Panel also notes that the reference to acid deposition in the air chapter seems out of place as presented. It would appear to be more appropriate to refer to acid deposition in the water and land chapters. That being said, the Panel recognizes that this may be a contradictory suggestion because EPA is being advised to provide greater integration while at the same time remove the reference to acid deposition (an integrating indicator) from the air chapter. However, it is not unreasonable for given indicators to appear in different chapters as long as there is a clear cross reference across the chapters and the reason for the cross reference is clearly explained.

The following specific recommendations are provided to improve the air indicators in the Report.

- **As stated in the overarching recommendations, a science framework should be incorporated into the air chapter of the final Report to show the interaction within, between and among media as well as between and among indicators.** The data presented must be explained because data presented in isolation are not science. In addition, the health/environmental relevance of the air indicators should be better documented with more extensive reference to the epidemiologic evidence as well as the environmental evidence.

- **In the final Report, a short historical section should be added to the air chapter to provide background information on the criteria pollutants.**

- **In the final Report, SO_2 concentration should be added to the air chapter as an indicator.** The Panel notes that this is a "good news" story for both EPA and the environment. SO_2 emissions controls have resulted in significant reductions in

ambient SO_2 concentrations. This has also resulted in a reduction in the amount of acidic deposition attributable to SO_2 emissions.

- **In the final Report, an air toxics indicator should be added to the air chapter.** This is an important and rapidly emerging human and environmental health issue and it should be more completely addressed in the Report. Currently the air chapter presents an air toxics emissions indicator as an aggregate of 188 compounds. A more informative description could be presented to provide additional information concerning specific toxics (see also the following recommendation concerning the National Emissions Inventory). The Panel also notes a disconnect in data between 1990 and 1999 and suggests that the Agency could look at the possibility of using estimates to determine trends. Trends in ambient concentrations of toxics could be developed by looking beyond the regional scale to the local level where additional monitoring data are available. While it is true that in the current network the benzene data are the most robust, it should be anticipated by EPA that in the future the network will be more robust for additional chemicals of concern.

  Further, it is not clear in the text what the difference is between Persistent Organic Pollutants (POPS), Persistent Bioaccumulative and Toxic chemicals (PBTs), and Hazardous Atmospheric Pollutants (HAPS). Sometimes the terms air toxics and HAPS are used as synonyms. Since the ROE 2007 Science Report is to be read by the general public, it is essential that all of the terms used in the text be clearly and unambiguously defined and used consistently. This becomes an important integration issue when chemicals and the responses to those chemicals appear in different media chapters. Reference is made in the water chapter, for example, to compounds also found in the air chapter but no cross-referencing is evident.

- **In the final Report, a broader explanation of what is in the National Emissions Inventory (NEI) should be added to the air chapter.** This is important because there is reference in the text to the Toxic Release Inventory (TRI) and Persistent Bioaccumulative and Toxic (PBT) chemicals.

- **In the final Report, further analysis of the trends in air indicators should be added to the air chapter.** While it is important to know whether air indicator trends are increasing or not, it is important for the reader to understand the reason for the direction of indicator trends. The Report should state where have we been, where we are now, and where we are going. As it stands, there is no history provided on how the air indicators were developed or evolved, or what may have influenced a certain trend (e.g., banning lead from gasoline resulted in a precipitous decline in atmospheric lead concentrations).

- **In the final Report, an indicator should be added to the air chapter to focus on the clear reduction of primary pollutants (CO, SO_2, and Pb) but much flatter trends in secondary pollutants (O_3 and $PM_{2.5}$), reflecting the growing importance of secondary air pollutants.** These pollutants are becoming increasingly important as regulatory efforts have resulted in reductions of major primary pollutants. Such an

indicator would allow EPA to show the interaction of the atmospheric components and would help pull the pieces together conceptually. It also allows one to discuss more complex issues such as climate and ozone.

- **In the final Report, a small section should be added to the air chapter to discuss how climate change is affecting aerosols.** A paragraph would be appropriate. This paragraph would create the opportunities in the text to emphasize the interactions among pollutants, the importance of secondary pollutants, and the complexity of the atmospheric chemistry.

Charge Question 3. Identification of gaps and limitations of the air chapter indicators

Overall, the Panel finds that most of the critical gaps and limitations of air chapter indicators have been identified. That being said, the Panel provides a number of suggestions for informational improvements to the gaps and limitations to provide a better understanding of the meaning and relevance of the indicators. The Panel finds that indicator limitations are presented in a generally pro forma and mechanical fashion. There is virtually no discussion of whether, and how, these limitations should affect the reader's interpretation of the estimates with regard to magnitude of point estimates or shape of trends. With the exception of the ambient concentration indicators for criteria pollutants, benzene, and manganese in Region 5, quantitative estimates of uncertainty are lacking, leaving unanswered questions concerning the robustness of the majority of the indicators.

The Panel also finds that in the discussion of gaps and limitations of the air indicators, more emphasis should be placed on how limitations fit into the "big picture," or how changes in outdoor concentrations may have increased or decreased the importance of other contributors to exposure and health risk. For example, given what is known, information should be provided to indicate how decreases or increases in ambient contaminant concentrations are reflected in total exposure and human and ecosystem health. It is important to know whether the trends in decreasing ambient concentrations for certain contaminants are reflected to the same extent in bio-measurements (human and other organisms) beyond Lead (Pb). These are questions that require thinking more comprehensively than the media-by-media presentation. The Panel also notes that in the air chapter, as well as other chapters, the final Report should offer approaches and/or solutions to filling gaps and limitations. The following specific recommendations are provided to improve the discussion of indicator limitations in the air chapter.

- **In the final Report, EPA should acknowledge and discuss the limitations of a single pollutant, local source approach to pollution control in the context of the marked reductions in individual pollutants documented by the indicators, and as exemplified by continuing challenges with regard to ozone and $PM_{2.5}$.** The significance of temporal trends viewed in the light of the importance of primary vs. secondary pollutants (specifically with respect to PM and ozone) should be discussed.

- **For the final Report, EPA should view the PM speciation network as the vehicle to provide the needed information on PM composition.**

- **In the final Report, the bias that may result from the choice of base year for trends for a given air indicator should be discussed, as this has implications in the interpretation of the air indicator data.**

- **In the final Report, the effects of trends in ambient concentrations of air pollutant indicators on exposure and dose should be discussed.**

Charge Question 4. Regionalization of the national Report on the Environment indicators in the air chapter

The Panel finds that the concept of having "national" as well as "regional" air indicators would be very informative if an appropriate approach were used. The main problem with the approach currently used in the air chapter is that the EPA regions are artificial administrative units that do not reflect airsheds. In addition, the national air quality data are dominated by data from urban air quality monitoring stations. The extrapolation of air indicator data from national to regional to subregional levels (e.g., states, cities) could be extremely misleading unless the inherent limitations of the data are clearly understood.

Charge Question 5. Utility of the regional indicators in answering the questions in the air chapter

The Panel finds that regional air indicators would be very useful as long as their application has a sound scientific basis. Unfortunately, this is generally not the case in the air chapter. As noted above, the EPA regions do not correspond to airsheds but rather artificial administrative units. That being said, the Agency could get around this dilemma by carefully defining the "region" according to an air issue. While two examples of regional indicators are provided in the chapter (Manganese within Region 5 and PM along the U.S.-Mexico border), the basis for the selection of these indicators is not evident. This illustrates the need for EPA to consider developing and providing air indicators for 'hot-spot' locations/areas. For future Reports on the Environment, more conceptual development is required by EPA with respect to applying regional and sub-regional (i.e., hot spot) air indicators.

Charge Question 6. Overall quality of the air chapter with respect to technical accuracy, clarity, and level of communication

The Panel finds that the air chapter fails to provide the critical links between the observed changes in concentrations of pollutants and the understanding of the functioning of the atmospheric environment. The air chapter benefits from a long record of atmospheric monitoring that provides a wealth of data. Data are an essential part of science because they provide the basis for developing an understanding of the sources, processes and fate of the measured constituents. However, the final Report should do

more than report data. The pollutant-by-pollutant presentation does not adequately reflect the understanding of the interrelationships among the measured species. As mentioned above, there are key trends in the understanding of the atmosphere that should be addressed in the final Report, such as the clear reduction of primary pollutants (CO, SO_2, lead) but much flatter trends in secondary pollutants (O_3, $PM_{2.5}$). NO_x has been controlled to the point where it does not have direct health impacts (the basis for the level in the NO_2 Primary NAAQS), but leaves concentrations that permit formation of O_3 and $PM_{2.5}$ that lead to air quality violations. As mentioned above, the discussion of VOCs in the air chapter is almost entirely focused on anthropogenic VOCs. However, it is now recognized that for many parts of the U.S., biogenic VOCs dominate. In addition, the relationships between climate change and stratospheric ozone depletion, and tropospheric chemistry that enhances key pollutants (O_3 and $PM_{2.5}$), provide an important link between these currently isolated aspects of the chapter and other air pollutants which the EPA monitors. Thus, to improve understanding of atmospheric processes and achieve continuing improvements in air quality, indicator data such as those currently presented in the air chapter must be treated as a valuable resource but not an end in themselves. More attention needs to be paid to the "one atmosphere" concept that EPA has been trying to implement, and to using the data to demonstrate how they have improved our understanding of the atmospheric system in the U.S.

7.0 WATER CHAPTER COMMENTS

Charge Question 1. Adequacy of formulation and scope of questions in the water chapter

The Panel finds that the overall broadness and consistency of the questions in the water chapter of the ROE 2007 Science Report are appropriate given EPA's mission and the scope of the Report. However, the questions in the water chapter do not adequately address the interconnectedness of different water systems and both land-water and air-water interactions. The Panel also finds that additional questions are needed to incorporate missing information on critical habitats and thematic elements. The following specific recommendations are provided to improve the formulation and scope of the questions.

- **In the final Report, the questions in the water chapter should be expanded to focus on the interconnectedness of different systems (both within the different water types and across media).**

- **In the final Report, additional questions should be included in the water chapter to incorporate missing information on availability and usage of water for human activities, especially with respect to both ground water and surface water withdrawals** (see data in Roy et al., 2005 and Solley et al., 1995).

- **In future Reports on the Environment, additional questions should be included in the water chapter to incorporate missing information on critical habitats or thematic elements such as:**

- Extent and condition of coral reefs;
- Wastewater management information (it is recommended that EPA review available National Pollution Discharge Elimination System data for possible useful indicators);
- Extent and condition of, and trends in, riparian zones and lake shoreline (i.e., land-water interface, where much of the biological activity occurs), and their effects on human health and the environment; and
- More national indicators and analyses providing data and information on non-indigenous invasive species.

- **In future Reports on the Environment, some key model aquatic systems should be identified in several ecoregions of the U.S. and data collected from these systems should be mined and analyzed in the context of questions presented in the Report.**

- **For future Reports on the Environment, EPA should examine the 2004 National Research Council Report on national and global water resources and water infrastructure problems, and the importance of research in addressing them (National Research Council, 2004)**. In this regard, relevant questions to be considered include: (1) Will drinking water be safe? (2) Will there be sufficient water to support both the environment and future economic growth? (3) Can effective water policy be made? (4) Can water quality be maintained and enhanced? (5) Will our water management systems adapt to climate change? While the Panel recognizes that some, if not most, of these questions are outside the narrowly defined scope of the ROE 2007 Science Report, EPA should consider addressing these questions because they help place the water media chapter into context.

- **In the final Report, EPA should examine the relevance of measures of "Extent and Condition" across all aquatic ecosystem types.** In this regard, the Panel finds that the question on the "extent" of coastal waters is not meaningful because for coastal waters, the issue of importance is their condition not their extent.

Charge Question 2. Use of indicators to answer questions in the water chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative

In general, the Panel finds that the narratives in the water chapter of the ROE 2007 Science Report have accurately captured the indicator data. However, there is a lack of acceptable water indicators to provide answers to the questions in the chapter. In this regard, the following concerns are noted.

- The indicators selected to address freshwater issues are all based on streams and rivers. It is problematic that there is no mention of any indicators for lakes, ponds, and reservoirs.

- The section in the water chapter on wetlands provides minimal analysis of available data. The Panel finds that addressing only loss or gain in wetland acreage as an indicator is not adequate.
- Only total nitrogen and phosphorus are used as nutrient indicators in the water chapter. Other nutrient indicators mentioned below should be considered.
- The drinking water section of the water chapter needs additional critical analysis to consider the implications of drinking water quality to human health. For example, the water chapter indicator dealing with "drinking water" covers only the number of systems that have not reported exceedances of maximum contaminant levels (MCLs). The Panel finds that it would be more informative to report this indicator in the final Report as the number of systems that have had exceedances, and include data on which contaminants were present and the degree to which they exceeded the MCL.
- The lack of microbial indicators in the water chapter makes it difficult if not impossible to ascertain human health implications and impairment of water resources due to fecal pathogen contamination, regulated contaminants, or EPA Contaminant Candidate List elements. In the case of pathogens, this is an unfortunate void (as implied in the water chapter limitations and gap analysis) given that there is a non-ambiguous (etiological) link between pathogen exposure and disease, albeit an unclear dose-dependent relationship. In earlier U.S. EPA Water Quality Inventory Reports to Congress (U.S. EPA, 2000), pathogen data were evaluated and used to classify contributions to pollution of water resources. It was noted that pathogens were either the first or second primary pollutant contributing to non-attainment of water quality standards for estuaries, coastal shoreline, and rivers and streams. These data, once obtainable from the states, are apparently no longer accessible or have been judged statistically or probabilistically unreliable for accurate trend analysis. EPA should look for ways to obtain these data again (perhaps collaboratively with states).
- It appears that many of the indicators used in the water chapter are composite or multi-metric in nature. These indicators are useful, but the Panel recommends that they be complemented with single metric indicators that are easier to understand and require fewer caveats and assumptions.
- In the water chapter there is very limited inclusion of data on specific toxic industrial chemicals and contaminants, of either a regulated or unregulated nature, for which EPA has statutory responsibility under the Clean Water Act. Analysis of specific toxic and bioaccumulating chemicals, other than pesticides, is largely confined to fish tissue contaminant concentration. The lack of such information for streams, rivers, and sediments makes it difficult to discriminate sources of contamination and impairment (e.g., urban/industrial vs. agricultural).
- The water chapter data on “pesticides in agricultural streams” are comprised of measurements of concentrations in the water only. However, the Panel notes that many of these chemicals are hydrophobic and are better analyzed in the sediments and biota rather than in the water column, where they may appear low even in situations where biota may be impacted by their elevated levels in the sediments. It is also unclear why these concentrations were compared with EPA’s MCLs for drinking water. People are not generally drinking water out of agricultural streams, so the

focus on pesticide concentrations should be their toxicity to biota living in the streams, not to human consumers of drinking water.

- The section of the water chapter on "coastal fish tissue contaminants" includes analyses of many species of fish, and indicates that 22% of the sites showed high contamination. However, the contaminant data are pooled from many different species of fish and shellfish from different habitats, trophic levels, and age classes. The Panel notes that these factors strongly influence the degree to which a particular species bioaccumulates various contaminants.

The Panel suggests that in the water chapter of future Reports on the Environment it should be possible to develop internally consistent local or regional indicators (covering individual environmental units or ecological provinces) in those cases where data for national indicators are not available or do not meet the criteria for inclusion in the ROE 2007 Science Report. Indicator data from different watersheds or hydrological basins may not be directly comparable with each other, but the local or regional sets of data can provide meaningful temporal trends.

The Panel also finds that the final Report should contain better justification for some of the schemes used to grade indicators in the water chapter. In some instances (e.g., trophic state of coastal waters) the grading of "high, medium and low" quality are quite understandable. On the other hand, the low, medium, and high grading of "nitrogen and phosphorus in wadeable streams" presented on pages 3-22 and 3-23 is confusing. It is hard to understand why the grading is "low" when it is below the 75th percentile for the reference. It appears this system was used because of statistical analyses that are not discussed in the Report. Providing only qualitative indication (such as low nitrogen, medium nitrogen, and high nitrogen or low flow and high flow) is not adequate for those who would like to use this report as a guide to determine the state of these systems. The Panel suggests that it might be better to provide a range of values in the final Report for each of these parameters presented**.** The following specific recommendations are provided to address the concerns noted above.

- **In future Reports on the Environment, EPA should include appropriate indicators of condition of lakes, ponds, and reservoirs.**

- **In future Reports on the Environment, EPA should consider including the following important specific indicators:**
  - **Snow pack (extent, condition, and volume)**
  - **Pathogens (coliforms, enteric viruses, toxins, etc.)**
  - **Storm water and wastewater (contaminant effects)**
  - **Drinking water primary contaminants (e.g., microbial indicators and pathogens: bacterial, viral or protozoan)**
  - **Contaminants of emerging concern such as pharmaceutical and personal care products, perfluorinated chemicals, brominated flame retardants, nanoparticles, and others.**

- **In future Reports on the Environment, additional wetland data should be used.** In many areas, wetlands will indicate more efficiently the ecological integrity of the entire watershed than will any other portion of the landscape. New data on basic wetland soil, vegetation, and periphyton characteristics are now emerging in various ecoregions. These data can provide important information. In addition, some of the possible complementary or alternative wetland indicators may include biogeochemical processes, such as organic matter decomposition and accretion, denitrification, phosphorus saturation, sulfate reduction, and indices of biotic integrity (IBIs), which can provide early indications of impending ecological changes.

- **For future Reports on the Environment, EPA should evaluate whether nutrient indicators based on bioavailable nitrogen and phosphorus or nitrogen:phosphorus ratios may be more useful.**

- **For future Reports on the Environment, EPA should develop drinking water indicators based on the available data from the Agency's own databases and the consumer confidence reports released to the public annually by community water systems.** Based on these data, EPA could formulate indicators that can delineate trends in drinking water quality. The water chapter should include source water monitoring data in addition to treated water quality data.

- **For future Reports on the Environment, pathogen monitoring should be investigated as a primary indicator for water quality trends and human health effects across various water sources.** This recommendation would encourage more cooperation with states in providing data for analysis for longer term trends.

- **In future Reports on the Environment, composite or multi-metric indicators should be complemented with single metric indicators that are easier to understand and require fewer caveats and assumptions.** For example, the coastal benthic communities indicator could be supplemented with data on the abundance of key reference organisms that are particularly important to ecosystem function in each region (i.e., keystone species), or species that have special value to the stakeholders of the region (e.g., manatees in Florida or Coho salmon in Pacific Northwest).

- **In the final Report, data for the indicator "pesticides in agricultural streams" should not be compared to human health benchmarks.** In future Reports on the Environment, data should reflect pesticide toxicity to stream biota (e.g., sediment concentrations of pesticides could be considered).

- **In future Reports on the Environment, EPA should incorporate more information on specific toxic industrial chemicals for which the Agency has statutory responsibility under the Clean Water Act.**

- **In future Reports on the Environment, EPA should analyze fish tissue contaminant data by different species, or at least conduct separate analyses of**

fish from different trophic levels or different habitats (as was done for the "lake fish tissue" indicator) to see which species (e.g., piscivores) are more likely to have higher levels of contaminants than others.

Additional technical comments and recommendations concerning the specific indicators in the water chapter are provided in Appendices A and B of this report.

Charge Question 3. Identification of gaps and limitations of the water chapter indicators

In general, the Panel finds that EPA has effectively identified and communicated the gaps and limitations of the indicators in answering questions posed in the water chapter of the ROE 2007 Science Report. However, it is disappointing that many of the indicators used in the chapter are recent and do not include many years of prior monitoring to show trends, so this gap/limitation is cited frequently. This is in striking contrast to the air chapter of the Report in which numerous graphs with downward trends are presented showing the overall improvement in release and ambient concentrations of various air pollutants (with the exception of greenhouse gases which are going up). The Panel finds it hard to understand why the data collected for the last three decades on various water systems are not adequate to determine status of and trends in the ecological condition of water systems. The gaps identified in the water chapter (e.g., on page 3-40) for freshwater systems highlight the need for more data. The Panel notes that more data will not necessarily answer the questions presented in Report, but it may be helpful to use additional data from well-planned and consistent monitoring of representative systems.

In several instances the "indicator limitations" discussion in the water chapter addresses or provides recommendations on how to interpret indicators. In these instances the discussion is most often focused on interpretation of indicators to show human health effects. The Panel finds that the discussion of how to interpret indicators or, show what they mean, would fit better in the section of the water chapter titled, "what the data show." Alternatively, to address the need for cross-media linkages, it is suggested that EPA could add a separate section titled, "what does this mean for human heath." An example of such a limitation is on page 3-27 in the discussion of the nitrate in streams indicator. The text states that, "Drinking water treatment can significantly reduce concentrations of nitrate, so the level of contaminants reported in this indicator is not necessarily representative of exposures to people when these waters are used as public water supplies." The Panel notes that this is a separate issue from the sample design and temporal limitations of the data set, concerns that most commonly appear in the indicator limitations list. The interpretation statement included on page 3-27 raises important human health questions that could well be addressed by providing additional information. These include questions such as: How many communities rely on these streams for their water supply? How many communities rely on the streams that had nitrates above the MCL? How many communities treat their water for nitrate? The Panel notes that while treatment can reduce nitrate levels, it is often cost prohibitive and communities must find an alternate water supply. In addition, a high percentage of residents in rural areas depend on private water wells which have no treatment capability. Because surface water contamination in streams often has a direct bearing on ground water quality, how are the

exposures of these people affected? A similar issue is apparent in the limitations discussion of the "pesticide in streams" indicator on page 3-32. Important human health questions that could be addressed include: How practical is it to treat a community water supply for pesticides? and How many communities do this?

The Panel recognizes that the "Survey of the Nation's Lakes" will provide a valuable database in the future for assessing conditions of ponds and reservoirs that are representative of all lakes in the United States. However, in the interim, usable data that already exist should not be overlooked. For example, there is a wealth of information (and associated data) available on nutrients, especially for rivers, lakes, and coastal waters. The Panel recommends that staff visit (or revisit) EPA guidance manuals for lakes, rivers, coastal waters, and wetlands for potential data sets, if they have not already done so**.** In addition, long-term monitoring programs of EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S. Geological Survey's National Water Quality Assessment Program, the National Oceanic and Atmospheric Administration's Status and Trends and Mussel Watch Programs, and the National Science Foundation's Long-term Ecological Research and Long-term Research in Environmental Biology programs), and of states or universities should be examined. Indicator criteria should be relaxed (within reason) to enable the use of important trend data. It is important to be able to see the trends with appropriate caveats about methodologies used. This was done for the "SAV in the Chesapeake" indicator discussed on pages 3-74 to 3-75. In this case, data were adjusted to account for methodological inconsistencies. A similar approach should be adopted for other parameters (e.g., sediment contamination, tissue contaminants, benthic communities, etc.), if feasible. The following specific recommendations are recommended to address indicator gaps and limitations in the water chapter.

- **For future Reports on the Environment, EPA should visit (or revisit) the Agency's guidance manuals for lakes, rivers, coastal waters, and wetlands for potential data sets to fill identified data gaps.**

- **For future Reports on the Environment, long-term monitoring programs of EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S. Geological Survey's National Water Quality Assessment Program, and the National Oceanic and Atmospheric Administration's Status and Trends and Mussel Watch Programs), and of states or universities should be examined. Indicator criteria should be relaxed (within reason) to enable use of important trend data.**

Charge Question 4. Regionalization of the national Report on the Environment indicators in the water chapter

The Panel finds that regionalization of national indicators is an important component of the water chapter of the ROE 2007 Science Report. However, as noted previously, the Panel is concerned that the use of EPA administrative regions will distort true ecological patterns or gradients. If possible, in future Reports on the Environment the data should

be analyzed at more appropriate scales. For surface water, a more appropriate approach may be to use watersheds or established hydrologic units that also account for altitudinal gradients. For groundwater, EPA should evaluate the validity of using U.S. Geological Survey (USGS) groundwater basins as regional units. Contributing watersheds may be used as a scaling unit for estuaries.

The Panel notes that a regional approach will also aid in evaluating indicators to be used for various water systems during extreme events such as hurricanes, drought, and possibly bioterrorism. As noted previously, it is important for EPA to mine existing data and find ways to use these data to develop indicators for different ecoregions. For example, an enormous amount of data is collected by the five Water Management Districts in Florida on various water systems. Similar data sets exist for various ecoregions. For future Reports on the Environment, these data can be used to identify indicators.

Charge Question 5. Utility of the regional indicators in answering the questions in the water chapter

The Panel finds that there is considerable utility in using regional indicators to answer questions in the water chapter of the ROE 2007 Science Report. The regional indicators used in the water chapter answer parts of the questions to one degree or another but certainly do not address all aspects of the questions. The Panel suggests that additional regional indicators could be used to answer questions in the water chapter. One indicator used in the Report to respond to the question of the condition and extent of coastal waters and their effects on human health and the environment is the occurrence of dinoflagellate blooms on the west coast of Florida (e.g., *Karina brevis*). The Panel notes that dinoflagellate blooms (*Pfiesteria*) have been strongly linked to nutrient input in the bays of North Carolina and Virginia and could be possible regional indicators. In addition, recurrent harmful algal blooms (HABs) of *Alexandrium* off the coast of New England, brown tide (*Aureococcus*) in the middle Atlantic, and *Pseudonitzschia* off the coast of the Pacific Northwest are being monitored, among others. The Panel questions why harmful algal blooms in fresh waters and invasive species have not been included as indicators in the discussion of extent and condition of fresh surface waters. The Panel notes that a regional indicator would seem to make sense here, either based on Great Lakes or Everglades long-term data (National Oceanic and Atmospheric Administration, 2007; South Florida Water Management District, 2007). Occurrences of freshwater HABs such as *Microcystis* could also be used as indicators. In future Reports on the Environment, EPA should consider incorporating these and other monitored blooms into the HAB indicator in the water chapter. In the water chapter, there are seven other indicators listed in response to the question of the condition and extent of coastal waters and their effects on human health and the environment. Even taken collectively, these indicators do not answer all aspects of the question, although each indicator illuminates some facet of the problem posed. If EPA continues to use regional indicators in answering this question in future Reports on the Environment, it would be helpful to explicitly identify the benefits and limitations associated with each regional indicator vis-à-vis national indicators.

The Panel finds that for future Reports on the Environment, development of regional indicators focusing on individual water systems would be a useful way to identify common indicators across regions. For example, separate water systems could be divided into groups: lakes and reservoirs, streams and rivers, ground water aquifers, wetlands, estuaries, and coastal waters. Indicators used in each of these groups could be evaluated across ecoregions and climatic gradients. Regional EPA offices, in collaboration with USGS and state agencies in the region, could identify data sources and transform data into useable information for the Report on the Environment.

The Panel notes that as indicators are developed, there are a multitude of processes that must be integrated, some of which can be described in deterministic/mechanistic equations (e.g., water flux, sediment and contaminant transport) or stochastic models (e.g., climate change). In contrast, other complex processes that affect water resources, such as the behavior of population groups, are more difficult to incorporate into quantitative models. The process of indicator development will require transdisciplinary research and education to synergize expertise from various domains and develop holistic approaches or models that are modular, scalable, and flexible in order to link land and water resources to internal and external forcing functions. The following specific recommendations are provided to strengthen the use of regional indicators in the water chapter of the Report:

- **In future Reports on the Environment, EPA should utilize and build on existing databases that have been collected and existing local expertise that has been developed at benchmark sites in various ecoregions.** Some specific examples are provided in the discussion above and in the following recommendations. This effort should focus on addressing water quality and quantity issues that could potentially affect human, economic, and ecological health. The specific proposed goals of such an effort should be to:

  - Identify attributes of land and water resources that can serve as indices of sustainability, and develop field and laboratory methodologies to determine these attributes in space and time within different benchmark water systems;
  - Investigate the sensitivity and dependence of basin factors to internal and external forcing functions such as climate change, extreme events, water law, land use policies, and social customs;
  - Develop predictive tools that will aid in determining the interactions and linkages between hydrologic processes, biogeochemical processes and socio-economic factors; and
  - Expand institutional collaborations through partners and maximize the utilization of available resources to promote interdisciplinary research and educational activities in benchmark water systems.

- **In future Reports on the Environment, EPA should give state data sets much closer scrutiny for possible inclusion.** Some states have a wealth of area-specific data. For example, private well testing data are available in states with a high proportion of private wells, cf. the "Wellogic" system in Michigan (Michigan

Department of Environmental Quality, 2008) and local sport fish testing in states with strong recreational fisheries may mesh well with the existing national indicators. Highlighting what some states have done might help advance interest in expanding the efforts to develop a national surveillance system.

- **For future Reports on the Environment, the Panel recommends that EPA consider the following as an example potential local/regional indicator for use in the water chapter.** The State Water Resources Control Board of California is funding USGS to lead and conduct a Groundwater Ambient Monitoring and Assessment (G.A.M.A.) program (U.S. Geological Survey, 2008) under which groundwater samples from public and private water supply wells from California are analyzed for water quality. The data collected will be integrated with existing water quality data (such as the public supply well water quality data of the California Department of Health Services). The monitoring program is scheduled to repeat the collection and analyses once every ten years and therefore it will provide the badly needed information for temporal trends. Although this type of data set may not be useful in developing a national water quality indicator, it is nevertheless meaningful and very useful in answering many of the questions in the regional context.

- **In future Reports on the Environment, the Panel recommends that, in addition to the Gulf of Mexico and Long Island Sound, other places where hypoxic conditions tend to occur and are well monitored (such as Chesapeake Bay, the coastal waters off Oregon, and parts of Lake Erie) should be added to the hypoxia indicator.**

- **For future Reports on the Environment, EPA should develop indicators for arid regions.** In this regard the Agency should draw upon the numerous studies and data collection efforts conducted by various federal and state agencies in the western states where the climate is arid. Most areas in these states (EPA Region 9: California, Arizona, Nevada) can be classified as desert or semi-desert, and water resources issues (related to both water quality and quantity) are highly contentious.

Charge Question 6. Overall quality of the water chapter with respect to technical accuracy, clarity, and level of communication

The Panel generally finds that the water chapter is technically accurate and that the level of communication is appropriate. As noted above, additional indicators are needed to answer the questions in the water chapter. The following specific recommendation is provided to strengthen the overall quality of the water chapter and other parts of future Reports.

- **In future Reports on the Environment, a summary section should be included after each media chapter. In addition to summarizing information presented in the chapter, this section should also identify relevant emerging issues. In the water chapter such issues might include:**

- **Effect of climate change on water quantity and quality**
- **Emerging pathogens associated with climate change**
- **Chemicals of emerging concern**
- **Nanoparticle waste products**
- **Water availability and sustainability**
- **Invasive species**
- **Algal toxins.**

8.0 LAND CHAPTER COMMENTS

Charge Question 1. Adequacy of formulation and scope of questions in the land chapter

In the land chapter of the ROE 2007 Science Report, indicators are presented to address fundamental questions about the state of the nation's land and its effect on human health and the environment. The five questions in the chapter focus on trends in: the extent of land cover, land use, wastes, chemicals used on land, and contaminated land. The questions in the land chapter are appropriate although somewhat peripheral to the mission of the EPA. The first two questions (addressing land cover and land use) relate to land resource management, while the last three questions relate to land contamination. The Panel finds that an additional question is needed to address the important issue of soil quality and conservation. In addition, the Panel finds that, while the inclusion of the phrase "and their effects on human health and the environment" in each question is understandable given the mission of EPA, there are few land indicators in the Report that directly measure effects on human health. The following specific recommendations are provided to improve the overall formulation and scope of the questions in the land chapter.

- **In future Reports on the Environment, EPA should consider adding a fundamental question on soil quality and conservation to the land chapter**. The structure of the question could be parallel to the others in the chapter. While it could be argued that soil quality is covered conceptually under one of the existing questions, it is not obvious which one, and the Panel believes that soil quality and conservation is at the same level of importance as land cover, land use, etc. A variety of indicators could be established in relation to this fundamental question, including soil properties such as ability to hold nutrients (as measured by cation exchange capacity [CEC] or organic matter content), soil nutrient inventory (e.g., to assess loadings of nutrients and legacy phosphorus inventory), soil salinity (e.g., to assess long-term effects of irrigated agriculture), and others.

- **In the final Report, EPA should consider the following suggested revisions of the land chapter questions to improve their clarity.**

  - The word "trend" (used in the questions) has a specific meaning in statistical science. It needs to be made clear whether qualitative or quantitative trends (or both) are used in the land chapter (and other chapters) of the Report (i.e., "trend"

as used here needs to be defined). The definition of trend used in the Report can cover both statistical and qualitative assessment of change over time, as long as the intended meaning in a particular situation is indicated. The Panel suggests that trend information be developed wherever possible, and that EPA use both qualitative as well as quantitative data to generate trend information for all indicators.

- The waste deposition addressed in Question 3 (wastes) could be considered a "land use" issue and included as a subtopic of Question 2 (land use). However, the separation of waste management is understandable, as it is recognized that the hazardous and solid waste management programs run by EPA are large and important land media activities for the agency.

- Waste deposition on land has impacts on groundwater that are likely of equal or greater significance than the direct impacts on land. Thus, the topic encompassed by Question 3 has overlap with the fundamental question regarding groundwater in Chapter 3, and in the introduction there is a need for an explanation of integration among components of the Report.

- The indicators presented in relation to Question 4 (addressing chemicals used on land) focus on agriculture. The agency may wish to explicitly identify agriculture as the focus of Question 4. An alternative would be to include agricultural land indicators under Question 2 (addressing land use), considering agriculture as a specific land use.

- Question 5 (addressing contaminated land) has some overlap with Questions 3 and 4. The "contaminated land" issue that is addressed by Question 5 (e.g., from pesticide use, industrial waste disposal, etc.) can be viewed as subsidiary to Questions 3 and 4. The factors distinguishing Question 5 (addressing contaminated land) from Questions 3 and 4 should be explained more fully.

Charge Question 2. Use of indicators to answer questions in the land chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative

The Panel finds that the five fundamental land chapter questions are not completely answered by the indicators presented, and in some cases are answered only in very small part. Further, most of the indicators do not by themselves represent a direct causal relationship to human and environmental health. However, the Panel recognizes that presently it may not be possible define land indicators that are directly linked to health effects.

The following recommendations are provided to improve the use of indicators to answer questions in the land chapter. Additional specific technical comments concerning the land chapter indicators are provided in Appendix A.

- **In future Reports on the Environment,** with respect to the land chapter indicators the Panel recommends that EPA should: **1) consider a range of land cover classification schemes with different levels of resolution.** This is necessary because the resolution of the data in the current Report is too coarse to completely answer the questions; **2) characterize land cover of all major ecosystem types**, not just the forest land cover characterized the current draft of the Report; **3) adopt standard, established approaches for land use and land cover analysis to evaluate information and document trends across a range of available data sets.**

- **In the final Report, EPA should include more direct indicators of effects in the land chapter.** For example, stream water quality associated with particular land uses could be used as an indicator. In addition, as in other chapters, a better explanation of the reasons for choosing the indicators used should be provided.

- **In the final Report, EPA should consider adding indicators for mining wastes, and wastes applied on agricultural land (biosolids, compost, etc.)** The Panel finds that the two waste indicators in the land chapter are appropriate, but adding these additional indicators would provide important information about waste on land.

- **In the final Report, EPA should add an indicator based on the generation and disposal of civilian radioactive waste.** This will fill an important data gap. The Panel recognizes that some data on defense radioactive waste may not be publicly available. However, it is recommended that EPA staff work with the U.S. Nuclear Regulatory Commission to obtain statistical information on status and trends concerning civilian radioactive waste generation, disposal, and management (U.S. Nuclear Regulatory Commission, 2007).

- **In the final Report, a pesticide use indicator should be added to the land chapter.** This could be done by renaming the existing indicator, "fertilizer applied for agricultural purposes," as "fertilizer and pesticide applied" and adjusting the type of data used to populate the indicator. In this regard, one possible indicator that could be used is pesticide sales. Pesticide sales could likely be parsed into agricultural and residential/commercial landscape applications. The latter would provide a suburban/urban indicator, which is important from the standpoint of human exposure.

- **In the final Report, the reported pesticide incident indicator should be moved to the human health chapter.** The Panel finds that the decline in reported pesticide incidents has a direct relationship with human health. However, the link between reported pesticide incidents and the human health impacts of land management practices is tenuous. Reported pesticide incidents cover all sorts of uses of pesticides, and are based on calls to poison control centers. Many of these incidents are related to misuse of household products and activities far removed from land management.

Charge Question 3. Identification of gaps and limitations of the land chapter indicators

The Panel finds that the discussions of indicator information gaps and limitations in the land chapter are objective, honest and insightful. In many cases, these sections point out why particular indicators do not provide the comprehensive picture that is needed or are "not ready for prime time." However, with respect to data gaps, much more could be said for each question. The data gap topics chosen for discussion seem somewhat arbitrary, though the data gaps discussions do uniformly address the lack of measures needed to directly assess the relationship of the indicator values to human health. Therefore the Panel recommends that:

- **In the final Report, the discussions of the data gaps in the land chapter** should be modified to make it clear that the gaps mentioned **are the highest priority gaps determined by the agency, and that the list is not intended to be comprehensive**.

Charge Question 4. Regionalization of the national Report on the Environment indicators in the land chapter

Concerns about the use of EPA administrative regions to regionalize national data have been noted previously. The Panel also notes that for future Reports on the Environment, the Agency may wish to consider the utility of the land chapter for cross-media evaluations if EPA regions were keyed to important environmental factors. The Panel notes that no single regionalization approach fits all evaluation needs. In the age of geographic information systems (GIS) there is no need to oversimplify. Therefore, in evaluating the condition of land, for example, EPA could select a particular level of USGS Hydrologic Units and overlay an ecoregionalization scheme. Bailey's U.S. Forest Service (USFS) Ecoregions of the U.S. (Bailey, 1995) or Omernik's Ecoregional schema (Omernik, 1987) would be appropriate because these combine soil, elevation, moisture, vegetation, and other factors.

In future Reports, different types of regional groupings could be used to show the location and extent of features in various chapters of the ROE. For example, as further discussed in Section 10 of this advisory report, ecologically relevant units such as watersheds, climatic provinces, and major coastal realms could be used to regionalize data. At the beginning of a future Report, it would be useful to discuss how the indicators have been regionalized (i.e., an ecologically relevant regionalization scheme has been selected based on a type of indicator).

Charge Question 5. Utility of the regional indicators in answering the questions in the land chapter

As further discussed in Appendix A of this advisory report, the Panel does not find the one regional example in the land chapter (the Puget Sound/Georgia Basin example given in the Land Cover subsection) to be very useful. It is sufficiently unique that it is not seen as providing much value as a national model or case study. The Panel could not determine why this example was included, nor was it clear how this example could be standardized for use in other regional analyses. However the Puget Sound case study exemplifies how an indicator (impervious cover) in one medium (land) has clear

implications in another medium (water). Unfortunately, there is no explicit linkage to the water chapter of the ROE. As discussed above, a conceptual model could be used to illustrate such linkages. It would also be useful to include examples from more than one region in the Report. Examples and case studies of significant national importance (e.g., from the Great Lakes region) should be given preference.

Charge Question 6. Overall quality of the land chapter with respect to technical accuracy, clarity, and level of communication

The Panel finds that the land chapter is generally clearly written and technically accurate. The data presented are interesting and will be useful for multiple purposes. However, in most cases, the fundamental questions in the land chapter are far from completely answered by the indicators and indicator data available, and the big picture understanding that the public may expect is not achieved. The data gap discussions are brief and the Panel recommends that they be reviewed and expanded where appropriate. In addition, while the Report writers clearly made strong efforts to avoid interpretations regarding influence of programs, some interpretation statements have made their way into the Report and should be removed. For example, the Report states that recycling efforts related to municipal solid waste have increased "most likely due to the increased awareness about the benefits of recycling and the implementation of policies by state and local governments tying waste generation directly to the cost of waste services."

The Panel also finds that the range of indicators in the land chapter is not at the same level of development as indicators in the water and air chapters. This is understandable given that EPA does not have a land program comparable to its water and air programs. The modest level of development of the land chapter must ultimately be addressed through direction of additional resources and an expanded set of disciplines in the Agency.

9.0 HUMAN HEALTH CHAPTER COMMENTS

Charge Question 1. Adequacy of formulation and scope of questions in the human health chapter

The panel generally finds the questions in the human health chapter of the ROE 2007 Science Report to be comprehensive, appropriate, and well developed. There is strength in the simplicity and clarity of the questions. However, the Panel recommends the following specific revisions to improve the scope and clarity of the questions.

- **In the final Report, the questions in the human health chapter should be reordered to be consistent with event sequence in the environmental health paradigm as depicted in Figure 5.1 of the Report** (i.e., exposure precedes the health effect).

- **In the final Report, the human health chapter should be more descriptively renamed as "Human Exposures and Health."** This change is needed because the questions contained in the chapter encompass both human health and exposure. In addition to be being more descriptive, the inclusion of "exposure" within the chapter title offers the following advantages:

  - It appropriately elevates exposure assessment within the ROE as a central and critical domain within EPA;
  - It is a key tenet of the ROE to link environmental change to human and ecological change; and
  - It provides a more appropriate place to include National Health and Nutrition Examination Survey (NHANES) pesticide body burden measurements that are currently out of place in the land use chapter.

There were differing opinions among panelists regarding the adequacy and scope of the first question in the chapter, "What are the trends in health status in the United States?" Some panelists thought that because the environmental factors considered in the Report play relatively small roles in the epidemiology of major U.S. health trends (i.e., general mortality, life expectancy, and infant mortality), such broad health-related conditions would have limited utility as environmental health indicators *per se*. Others felt that this question was appropriate in highlighting EPA's health mission. There was some consensus around a compromise suggestion to eliminate this question in the final Report but retain the content as introductory text to the subsequent, more specific health question, "What are the trends in human disease and conditions for which environmental contaminants may be a risk factor, including across population subgroups, and geographic regions?" In contrast to the previous more general question, there is strong justification for the inclusion of this question in the final Report.

Charge Question 2. Use of indicators to answer questions in the human health chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative

The Panel finds that the indicators used in the human health chapter of the ROE 2007 Science Report are appropriate. However, as discussed below, additional indicators are recommended to more completely answer the questions. In addition, there is a critical need to expand the discussion of the health indicators' relevance to the questions. This discussion can appropriately stem from the following indicator criterion on page 1-7 of the Report.

> "The indicator is useful. It answers (or makes an important contribution to answering) a question in the Report on the Environment."

Although there is strong epidemiologic evidence that supports the indicators chosen (cancer incidence, childhood cancer incidence, cardiovascular disease, chronic obstructive pulmonary disease, asthma, infectious disease, birth defects, low birth weight, preterm delivery) the Panel finds that the Report fails to take advantage of this literature to provide either a qualitative or quantitative description of the environmental

contribution. For example, what is the estimated fraction of cardiovascular disease that can be attributed to air pollution? Although the Report acknowledges that the health questions are complex and have multiple causes, it fails to provide a quantitative or even qualitative assessment of the relevance of the indicator to the question. This is an important consideration in providing the reader with the necessary context for understanding the meaningfulness of the indicator in the context of the health question. For example, there are scientifically credible estimates for the contribution of the environment to various cancers (Doll and Peto, 1981; Lichtenstien et al., 2000) and such information should be provided in the Report. There are similar estimates of air pollution contributions to asthma and cardiovascular morbidity and mortality (U.S. Environmental Protection Agency, 2005). The Panel therefore recommends that:

- **For the final Report, if credible quantitative impact estimates are available** (e.g., estimates of the mortality impacts of particulate air pollution in selected locations in the U.S.), **they should be included.** Establishing the relevance of the indicator grounded in the literature will go a long way toward strengthening the science of the Report.

- **In future Reports on the Environment, EPA should consider using an expanded suite of human health indicators** that would include the following:

  - The National Health Interview Survey (NHIS) (Centers for Disease Control and Prevention, 2008a) and Behavioral Risk Factor Surveillance System (BRFSS) (Centers for Disease Control and Prevention, 2008b). This is a population-base survey administered by states and includes the relevant domains of Secondhand Smoke Policy (Module 10), Indoor Air Quality (Module 11), and the Home Environment (Module 12). These modules include salient indicators for indoor air quality: 1) the use of gas appliances; 2) use of a coal stove, fireplace, or kerosene heater; 3) use of pesticides; 4) whether smoking is allowed indoors at home and at work. Because these data are collected at a state level, there is sufficient resolution to the data for use as a regional as well as a national indicator (this recommendation also is relevant to the air chapter).
  - Hospital and emergency room discharge data (if publicly available).
  - Reports of infectious disease maintained by CDC (Centers for Disease Control and Prevention, 2007).

- **In future Reports on the Environment, EPA needs to adopt the suites of indicators that other agencies have developed, but present them in relation to environmental factors**.

Charge Question 3. Identification of gaps and limitations of the human health chapter indicators

The Panel finds that the identification and communication of gaps and limitations of the indicators in the health chapter are adequately addressed with some potential areas for

improvement. The following recommendations are provided to improve the identification of gaps and limitations:

- **In the final Report, the discussion of gaps and limitations should be expanded to include a more quantitative description of indicator relevance by relying on the epidemiologic** literature (this is also addressed in the indicator discussion above). The discussion might be further expanded to address how the limitations and gaps affect the interpretations of the Report on the Environment indicators, or the larger framework of the disease state or indicator.

- **In the final Report, the concept statements in the indicator limitations sections such as "the measurement of mercury or any other environmental chemical in a person's blood or urine does not by itself mean that the chemical has caused or will cause harmful effects in that person" should be removed** from each discussion of indicator gap and instead be placed in the conceptual framework section of the chapter.

Charge Questions 4 and 5. Regionalization of the national indicators and utility of the regional indicators in answering the questions in the human health chapter

As noted previously, the Panel finds that regional analysis will make the Report on the Environment richer and more meaningful. Nationally aggregated data cannot reflect local and regional environmental or health trends that are important to the quality of life and health of the residents living in these areas. Regional indicators as presented by EPA administrative regions are not particularly informative geographic descriptors of health. The Panel notes that geographic units such as ecoregions and watersheds are far more useful for presenting regional information. Using such units to present health data would be a novel approach that would set the Report on the Environment apart from the already existing health data presentations. The finer the spatial scale of this analysis, the more valuable it becomes. The finest spatial resolution contained in the Report is at the EPA regional level and trend analysis is shown simplistically as line graphs. The Panel notes that even for this relatively simple analysis, and certainly as the Report on the Environment is developed to include indicators with greater spatial resolution, more sophisticated and innovative means of analysis and presentation will be required.

For some of the indicators, resolution can go down to the state and even the county level (indicators derived from birth and death certificates) thus making it possible to aggregate the data in many geographic patterns. The NHIS survey data and the Survey Epidemiology and End Results (SEER) cancer data (National Cancer Institute, 2008) only have national resolution. However, state-based surveys such as the BRFSS can provide much of the same disease prevalence data as the NHIS with resolution at the state level. State cancer reporting registries are available in nearly all states and, while not as rigorous as the SEER program, provide credible cancer incidence data widely used by states without SEER registries. It would be helpful for EPA to provide "regional" reports that were integrative and coherent. The current approach does not provide much benefit. Therefore the Panel specifically recommends that:

- **In the final Report, EPA should build on the higher geographic resolution theme by presenting individual or multiple state data which could inform the gross national estimates presented and point toward the future.** This should be done if possible, given the time constraints of revising this version of the ROE.

- **For future Reports on the Environment, EPA should consider making use of county-level data available from the states.** All of the vital statistic data presented and used for the EPA Regional indicators can and have been scaled to the county level and excellent maps have been generated and already published in books. Geographic differences in disease have been identified. Virtually every state provides tables and maps of their vital statistics by county and they are used to identify local priorities to allocate targeted interventions and funding, yet on page 5-68 of the ROE 2007 Science Report it is stated that "underlying data for most ROE indicators …do not enable extensive analysis of disease trends within or across geographic regions." The Panel notes that this statement only pertains to the NHIS survey data. Certainly cardiovascular disease, stroke, and chronic obstructive pulmonary disease mortality can be presented at the county level or certainly the state level.

Charge Question 6. Overall quality of the human health chapter with respect to technical accuracy, clarity, and level of communication

The Panel finds that the human health chapter is generally technically accurate although limited in its assessment and synthesis. As with the Report in general, there is a need to further develop the chapter from its current form, which can be characterized as a data report, to a more sophisticated scientific document that includes assessment based on the primary literature and appropriate statistical analysis. The following specific additional recommendations are provided to improve the overall quality of the human health chapter.

- **In the final Report, Bullet #2 on page 5-5 should be rewritten to include biological agents.** The following sentence should be added: "Infectious diseases associated with environmental exposures or conditions are also addressed."

- **In the final Report, the discussion of sensitive populations should be expanded** because these populations are important in considerations of environmental health.

10.0 ECOLOGICAL CONDITION CHAPTER COMMENTS

The ecological condition chapter of the ROE 2007 Science Report addresses an extremely complex topic. The Panel recognizes that developing the chapter has been a difficult task, as it covers millions of species as well as populations, biological communities, and ecosystems, all of which interact with each other and are differentially affected by environmental factors. EPA is to be commended for tackling this important task. Compiling this information and pointing out the gaps and limitations is a very

useful project for the Agency, the scientific community, and the general public. However, the Panel finds that reorganization of the chapter is needed to reflect an integrated focus on ecosystem health. The ecological condition chapter should be reorganized hierarchically according to: 1) major ecosystem type, 2) ecosystem processes and services, and 3) ecosystem components (physical, chemical, biological). This is discussed in more detail below.

Structuring the chapter as recommended above will involve reorganization of material presently covered in the chapter and the inclusion of additional indicators discussed below. The Panel recognizes that many of the comments and recommendations provided below in response to the specific charge questions probably cannot be addressed in the final Report, but should be considered for future Reports on the Environment. However, the Panel recommends that EPA complete as much of the reorganization as possible for the final Report. The Panel also suggests that in the final Report, the ecological condition chapter include a synthesis of the independent indicators, and that it emphasize the connections between ecosystems and stressors.

Charge Question 1. Adequacy of formulation and scope of questions in the ecological condition chapter

In general, the Panel finds that the questions in the ecological condition chapter are formulated appropriately, although some revision of the questions may be needed as the chapter is reorganized as recommended below. An exception is the biomarker question addressing the level of exposure of specific plant and animal species to different forms of pollution and toxic chemicals. The Panel suggests that in the final Report, rather than focusing on trends in biomarkers, the question should refer to trends in exposure and effects of contaminants in organisms. Biomarker data are collected to analyze the trends. In addition, the Panel notes that it is important to show the linkages between the effects seen in the ecological condition chapter and the indicators discussed in the media chapters. For example, EPA should strengthen the link between sea temperature and sea level rise discussed in this chapter and greenhouse gases in the air chapter. The Panel therefore recommends that:

- **In the final Report, the climate indicator trends in the ecological condition chapter should be placed in a paleoclimatic context to distinguish between human induced changes and other long-term changes.** References to the Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a,b) should be included.

- **The Panel recommends that in the final Report, a question should refer to trends in exposure and effects of contaminants in organisms** rather than focusing on trends in biomarkers**.**

Although most of the questions in the ecological condition chapter appear to be germane, the associated indicators in the chapter seem to have been chosen because of the availability of data, not always because of their appropriateness to answer the

questions. In some cases there are significant gaps between the questions and the corresponding indicators. As recommended previously for other chapters of the final Report, EPA should provide the rationale for selection of these particular indicators. This rationale may be that for many desired indicators of ecological condition the needed data simply are not available. If a desired indicator has no data, the final Report should contain a statement of the need for data.

As further discussed below, the Panel also notes that the scope of indicators used to answer questions in the chapter needs considerable broadening to cover more ecosystem types, with the recognition that EPA cannot develop an unlimited set of indicators but should select those that address key ecological issues. **Easily accessible data may be available for some of these indicators and could be included in the final Report, while others will have to wait for future Reports on the Environment.** A critical issue to be considered is whether data must meet some test that many ecological studies may not achieve. The final Report will be more useful if it includes more information, and then discusses caveats about the methodology. Specific gaps in coverage (missing ecosystems, missing populations, and missing processes) in the ecological condition chapter of the ROE 2007 Science Report are identified in Appendix A.

Charge Question 2. Use of indicators to answer questions in the ecological condition chapter of the ROE 2007 Science Report and presentation of indicator data in the chapter narrative

In reviewing indicators used in the ecological condition chapter, the Panel considered the charge question in two parts: "Are the current indicators appropriately used to answer the questions?" and "Are these the correct indicators to answer the questions?" The Panel finds that the indicators in the ecological condition chapter provide relevant and useful information as an initial attempt to answer the general questions posed, but many of the indicators are not transparent. The limited number of acceptable indicators in the ecological condition chapter can offer only a narrow perspective or a snapshot, and many do not show temporal trends. They are hardly adequate. This argues for an introductory discussion of each indicator along with a conceptual process diagram so that the reader can better understand the role of each indicator and its importance relative to the questions asked. The Panel's specific recommendations to address these concerns are as follows:

- **In the final Report, EPA should reorganize the ecological condition chapter to focus on three major indicator categories: Ecosystems, Ecological Processes and Services, and Ecosystem Components.**

- **In the final Report, appropriate indicators should be included in the ecological condition chapter to provide information on the ecosystem extent** (e.g., land cover, land use, urbanization) **and quality /condition** (e.g., landscape integrity, connectedness, fragmentation, and contamination) **of major ecosystem types.** Examples of major ecosystem types include: forests, grasslands, shrublands, arid lands, wetlands, farmlands, freshwater, and coastal, marine, and urban ecosystems.

- **In the final Report, indicators should be included in the ecological condition chapter to represent important ecosystem processes and services such as: provisioning** (e.g., timber, fuel, minerals, and other services); **regulating** (e.g., disease, climate, and flood processes)**; cultural** (e.g., spiritual and aesthetic services)**; and supporting** (e.g., soil formation, primary productivity, pollination, decomposition, disturbance, nutrient cycling, hydrological/chemical cycling, carbon sequestration processes, and services such as clean air, clean water, and net production). These ecosystem services classifications were developed by the Millennium Ecosystem Assessment (2005). Potential indicators relevant to the ecosystem processes listed above include: fire frequency, floods, drought, algal blooms, invasive species, carbon storage, soil salinity, nutrients, and erosion.

- **In the final Report, indicators should be included in the ecological condition chapter to represent physico-chemical components of ecosystems** (e.g., soils, water, chemicals, snow pack, and physical habitats). Some physico-chemical indicators are already included in the Report (e.g., mean temperature and precipitation, sea surface temperature, sea level, stream flows, and nitrogen and phosphorus discharge into rivers and streams).

- **In the final Report, indicators should be included in the ecological condition chapter to represent biological components of ecosystems ranging from the genome to the community level of organization.** Such components include biodiversity, endangered species, invasive species, keystone species, and communities. Specific examples of biological component indicators include: the extent and range of communities (e.g., land cover, coastal benthic communities, and coral reefs) and particular taxa (e.g., birds, fish, macroinvertebrates, and submerged aquatic vegetation); the protection status of biological components (e.g., management policy and zoning information relevant to understanding status and future vulnerability); and threats. The Panel finds that the current indicators in the ecological condition chapter have too much reliance on vertebrates and not enough emphasis on small organisms (e.g., microbes, invertebrates, and flora).

In Appendix A the Panel has provided specific technical comments and suggested improvements concerning individual indicators currently used in the ecological condition chapter.

Charge Question 3. Identification of gaps and limitations of the ecological condition chapter indicators

The Panel finds that, in general, the limitations and gaps are assessed fairly and objectively, and are presented in a clear and transparent way in the ecological condition chapter. As in other chapters of the Report, it may be useful to subdivide this section into different types of limitations, such as geographic limitations, statistical limitations, data coverage limitations, etc. Limitations are often based on inadequate data or inability to interpret data because they are "incomplete." Often gaps or limitations are discussed

with an inadequate understanding of relationships between the indicator and the environment. This concern can be addressed by including a conceptual model in the chapter as recommended above. The conceptual model should indicate how stressors (drivers), responses and outcomes are perceived by the scientific community. As previously discussed, this will improve interpretation and discussion and help the reader understand the importance of the indicators.

As in other chapters of the Report, it is disappointing that so many of the indicator data are recent and prior monitoring data are not available to see temporal trends. As noted previously, there are many monitoring programs of EPA, other federal agencies, and states that have long-term data sets. These data sets may not be based on probabilistic surveys and the statistical approaches that meet the indicator selection criteria. However, they may provide good long-term data and, if appropriate, should be incorporated into future Reports on the Environment. The sampling deficiencies associated with the data should be discussed in the section on gaps and limitations. Ignoring decades of prior monitoring information because methodologies were not "up to" current standards results in the inability to see trends in many important parameters. The Panel notes that it is important to show trends and include caveats about methodology. As methods, indices, and statistical design continue to improve, EPA should not discard the present measurements in favor of the new and improved indices. When methods are changed, there should be a time when both the old and new methods are used in order to establish their comparability.

The Panel provides the following specific recommendations to improve the discussion of indicator limitations in the Report.

- **In the final Report, the discussion of "trends in diversity and biological balance of the nation's ecological systems,"** (on page 6-29) **should acknowledge that some systems inherently have different numbers and variety of species**, making it inappropriate to make comparisons between systems.

- **In the final Report, the discussion of "fish faunal intactness," should explain why 1970 is chosen as the reference year**.

- **In the final Report, trend data should be adjusted to account for methodological inconsistencies.** For example, in the discussion of "SAV in the Chesapeake" which shows trends since 1978, the Report on the Environment states that "methods changed over the course of this study. However, data have been adjusted to account for any methodological inconsistencies." The same should have been done with other parameters that are presented as a snapshot at one time but could have been used to show trends with adjustment. The Panel recognizes that not all data sets will lend themselves to this type of adjustment, but when possible, EPA should calibrate or adjust data from different periods that use different methodologies to allow comparability over time.

- **In future Reports on the Environment, EPA should use available information from the Agency's water quality criteria guidance manuals.** As noted in the water chapter discussion, EPA has previously conducted a detailed review of current information to develop water quality criteria guidance manuals for lakes, rivers, and coastal waters. It is not clear whether this information was used in addressing some of the questions raised in the Report.

Charge Question 4. Regionalization of the national Report on the Environment indicators in the ecological condition chapter

As discussed previously, regionalization is an important element in the Report on the Environment. However, the EPA regions, while important for administrative purposes, are not relevant for representation of regional indicators in the ecological condition chapter. The separation of data into the ten EPA regions may inadvertently convey inaccurate ecological information to readers. For example, Exhibit 6-2 shows the changes in acreage in the extent of forested land in the U.S. broken down by EPA regions. However, the Report fails to recognize the differences in climate, biomes, and the amount of total area among these ecologically distinct units. The Panel finds the basis of the division to be misleading. Ecologically relevant units, such as watersheds, climatic provinces, major coastal realms, forests, etc. provide a scientifically sound basis for conceptual and statistical analyses. Results from ecoregional analysis could easily be reported in the final Report for EPA administrative units by using current GIS technology. It could be mentioned early in the final Report that some indicators will be regionalized based on the type of indicator (e.g., one that relates to large watersheds, such as nutrient discharge to oceans; or to major climatic zones, such as forest indicators). In this way objectivity of regionalization is addressed. Because there is little comparison across indicators in the Report, comparability across regions is limited. This suggests a future need for some kind of cross-reference table or section in the final Report that addresses the issue of comparability of indicators, questions and regions.

Charge Question 5. Utility of the regional indicators in answering the questions in the ecological condition chapter

The Panel finds that regional indicators in the ecological condition chapter have value and should be retained but with qualifications. Although regional examples have value for the national report, caution should be used in applying interpretation of regional examples on a national basis. As discussed above, the shortage of acceptable national large-scale indicators can be remedied by developing regional or local indicators. However, the justification of the inclusion of these particular indicators in the chapter is not clear. The use of a region to demonstrate some trend or change is useful if it represents scaling of similar national data. Some of the data sets are sufficiently complete to support useful regional subdivision, while others are not. Scaling decisions should be made on an indicator-by-indicator basis. If a regional indicator has been included in the Report only because a particular EPA region developed the methodology and collected the data (e.g., ecological connectivity in EPA Region 4), the indicator should be tested in another region that is not geographically or physiognomically

equivalent. If the indicator represents an "interesting" region (e.g., Puget Sound area) where analysis of changes has been completed, it should be pointed out that the uniqueness of the study may make it difficult to duplicate across the nation.

The following recommendations are provided to improve the use of regional indicators in the ecological condition chapter.

- **In the final Report, it should be clearly stated that specific case studies in the Report may not be representative of a general or national situation.** These concerns should not constrain the use of regional examples if developed in a fashion similar to other indicators with emphasis on the importance and applicability of the example.

- **In future Reports on the Environment, specific case studies using regional indicators should be selected for their ability to demonstrate the long-term trends that cannot be accomplished at the national level.** It would be useful to pick well-studied sites (e.g., Lake Mendota, Lake Tahoe) where there are long-term data sets available for each region.

- **For future Reports on the Environment, some of the regional indicators should be expanded to become national indicators** (e.g., SAV, invasive species, harmful algal blooms).

Charge Question 6. Overall quality of the ecological condition chapter with respect to technical accuracy, clarity, and level of communication

As noted above, the ecological condition chapter provides relevant, accurate, and useful information, but it is far too limited in scope. The nation's ecosystems and key ecosystem processes are far more extensive than represented in the Report. One problem is the immense difference between the objectives and base questions for the Report and the availability of applicable information to meet these objectives. The ecological condition chapter of the final Report would benefit from improved organization, as mentioned previously. The general introduction of the final Report should include a description of how all the themes are or can be integrated. To improve integration it would be possible to take a regional approach (e.g., large watershed) and show how each theme can be integrated within the region. This is something that should be considered for future Reports on the Environment. The Report also makes scaling difficult. Regional data need to be scaleable to a larger region or nationally, and national data need to be scaled to regional levels for application and understanding of the data. A more consistent and defensible approach is needed in future Reports on the Environment to deal with regionalization of indicators.

There is no easy way to develop ecological condition indicators, populate them with data, and then interpret the results. One approach requires use of conceptual models that show how indicator selection was achieved and how the indicator actually "indicates" the consequences of changing stressors, processes and outcomes. The authors should be

commended for their ecological condition paradigm diagram Exhibit 6-1. A conceptual model of flows between stressors and outcomes will look quite different from this general interactive model but, as discussed previously, this type of diagram showing interactions among many processes and attributes should be placed at the beginning of the document. The ecological condition paradigm is an excellent conceptual framework, but not well used in discussions of the indicators. The interconnections of human health and ecological condition with each other and with the media chapters should be discussed and expanded. This approach would greatly improve the level of communication. For example, the schematic that the SAB provided in its prior advisory report to demonstrate interconnections should be consulted because it is still germane and would improve the Report on the Environment. The inclusion of a statistical approach to analysis of the data, and consistent use of metric measures would also add rigor and are needed in a scientific document.

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Appendix A: Specific Technical Comments and Corrections

General

- In the final Report, EPA should identify, perhaps by using a letter (e.g., "H"), those indicators that explicitly relate to human health. Such identification will help differentiate those indicators from others that relate more to ecological health. For example, indicators presented on pages 3-32 (pesticides in agricultural watersheds), 3-44 (nitrate and pesticides in shallow ground water in agricultural watersheds), 3-90 (population served by community water systems with no reported violations of health-based standards), and 3-103 (coastal fish tissue contaminants) include a health component because of health based standards.
- In some cases, data are presented for each of the 9 ecoregions (e.g., Exhibit 3-3). The type of panel in Exhibit 3-3, showing a map of the 9 ecoregions, with stacked bars emanating from each region, should be more frequently used in the Report because it is much more informative than aggregated data. This is recommended as a revision for future Reports on the Environment.

Air chapter

Ambient Concentrations of Lead (Figure B on page 2-22)

- The caveat regarding the lead trend sites above the NAAQS is not really useful since the last year with a concentration above the NAAQS was 1982. The description in the narrative is sufficient for describing this event and the Figure is not necessary. It is not clear if excluded sites could be useful for establishing trends in more recent years. In the final Report, perhaps the X axis in Figure B could be modified in a manner similar to the NO_x or other NAAQS emission trends as presented in Figure A on page 2-24 or SO_2 on page 2-54.

Particulate Matter (PM)

- With regard to PM, a significant fraction of the 2.5 size range results from secondary formation. The Report on the Environment does not mention the potential use of the PM characterization sites (which also provide data on elemental composition and elemental carbon/organic carbon [EC/OC]). These sites have been operational for several years and it would be worth considering in future Reports on the Environment. At a minimum, there is probably enough data to provide a snapshot of regional differences in broad ranges of composition (North American Consortium for Atmospheric research in Support of Air Quality Management – NARSTO data, for example).

Acid Deposition Data

- The presentation of acid deposition data is visually attractive but the format is discordant with how data are presented for other pollutants (i.e., charts). The graphical format on pages 2-59 and 2-60 is difficult to follow in its detail as compared with the chart (bar graph, pie chart). Thus it would seem for added

clarity in understanding national and regional trends, in the final Report it would be advisable to follow the format used for the other pollutants in the air chapter.

Water Chapter

Presentation of Data

- On rare occasions, the discussion text in the water chapter is not consistent with the data being presented. For example, in the discussion of "coastal benthic communities" on pages 3-71 to 3-73 it is shown that 17% of area of all the U.S. coastal waters have low index values, and that 27% of the area in U.S. EPA Region 3 has a low index value. The Panel notes that a substantial portion the area of U.S. coastal waters (20 to 25% of the area) has a low index, and in addition there are extensive areas with "moderate" rather than "high" condition. However, in the discussion on page 3-85 of the water chapter, the Report states that, "Benthic communities in the nation's estuaries are largely intact in terms of species diversity… which is critical because these organisms are a fundamental link in the coastal food web." While the second part of the sentence is true, the first part is the statement is not supported by the data. The Panel recommends that in the final Report this misrepresentation of the data be corrected.

High and Low Stream Flows

- "High and low stream flows" is not an accurate characterization of this indicator. The data also address timing, but this is not intuitive from this heading. A more accurate title is recommended for the final Report.
- Page 3-15 lines 5-11: The text is confusing in this section. First, the word "substantially" is vague, perhaps intentionally, and lacks rigor. Second, what does substantially "larger low flows" mean? Is this an increase in volume for low flows? A greater number of streams experiencing low flows? Or does it mean something else? This should be clarified in the final Report.
- 3-15/24-32: it might be instructive to know if the change in timing showed any type of pattern. Was there more often a delay or an acceleration, or was there no distinct pattern? Distinct patterns may be useful to identify, as they may be related to withdrawal patterns or climate change influences.
- Since this indicator comes directly from the Heinz Center Report, EPA should look into how Heinz has modified its data.

Nitrogen and Phosphorus in Wadeable Streams

- 3-22/1: This indicator should be labeled Total N and P, not just N and P, to be accurate.
- Although there are geographic limits to the data, much of the land cover that sends waters to the oceans is covered. Limitations on what is not included are explained. It might be mentioned in the final Report that many if not most of the rivers in the Southwest do not discharge into the ocean, or if they do, much of the river has already been diverted for other purposes.

Nitrogen and Phosphorus in Agricultural Watersheds

- 3-25/10: The important point is not that nitrite and ammonium are not *present*—rather, they are present but in low concentrations.
- 3-25/20: Clarify in the final Report that it is the decomposition of the excess algae that can deplete oxygen in water. Also, include internal P loading from sediments as a potential P source, especially in shallow lakes.
- 3-26/3: The low range for phosphorus is still quite high, and indicates eutrophic conditions for most systems. It is unclear why such a high threshold was chosen for the low end of this indicator. It is not surprising that such a high percentage fell into this low category, but its significance is debatable. Clarify this in the final Report.
- 3-26/10: Flow-weighting makes considerable sense, given the aggregation of data. However, it would be very instructive if the data were analyzed for base flow and storm event periods, assuming the data set allows this type of analysis.

Nitrogen and Phosphorus Discharge from Large Rivers

- 3-28/1: In the final Report replace "Discharge" with "Load"
- Exhibit 3-9: As noted in the text, load is a function of both discharge and concentration—in the final Report it would be instructive to have discharge data also included in this figure, to see how much of the change in load is a function of discharge vs. concentration. While both drive load, changes driven by the former are more climate related, while changes driven by the latter are more a function of land use practices, and therefore more related to human activities. This is an important distinction.
- In future Reports on the Environment statistical analysis (trend analysis) is recommended for these data to determine if these trends are significant or not.

Pesticides in Streams in Ag Watersheds

- Exhibit 3-11: There is considerable value in disaggregating the data into at least a few key pesticides. In the present format, there may be considerable improvement or declines in a key pesticide, but the trend would be masked. While there is presentation value in aggregated data, it also can lead to misinterpretations—if the aggregated data need to be retained, they should be enhanced in the final Report by adding trends on a few key pesticides.
- 3-33/25: Include a map of the watersheds in the final Report to show explicit geographic distribution of the data collection.

Benthic Macroinvertebrates in Wadeable Streams

- 3-36: The explanation of the O/E model will be difficult for many readers to follow. This may be an acceptable limitation, especially if the intended audience of the Report on the Environment is scientists, but others will balk at the non-intuitive narrative. .
- What is the justification for the inclusion of these 3 ecoregions? Why not more, less, others?
- Exhibit 3-13: Why are the O/E data not shown in a geographic context, as well?
- Data from the wadeable stream sampling are suspect, not because of the sampling technique but rather the timing. Samples are taken from April to November and

then treated equally. Certainly streams change considerably over this time, both in physical and chemical characteristics.

3.2.3 Discussion

- 3-39/30: These indicators do not reveal the role of precipitation—the load indicators don't provide any precipitation information, and in fact, as currently presented, mask the role of precipitation.
- 3-39/33: This should be rephrased in the final Report—the chemical and physical indicators are proxies, at best, for the biological condition of the fresh surface waters. The Report on the Environment provides a very limited picture, not a mixed picture, of biological conditions, simply because there are so few biological indicators to this point. The only trophic level discussed for surface fresh waters in the entire U.S. is benthic invertebrates—nothing about bacteria, algae, macrophytes, fish, or waterfowl. Hence, it is misleading to state the biological condition index is mixed—there simply are insufficient data to draw any conclusions about the overall state of the nation's surface fresh water biology.
- The final Report should include something on waterborne pathogens in this section; even if it is not an indicator, perhaps there can be cross-references to other sections where this indicator is discussed.

Nitrate and Pesticides in Shallow Ground Water in Ag Watersheds

- The indicator "nitrate and pesticides in shallow groundwater in agricultural watersheds" does not match well with the question it addresses in the Report because as it fails to inform on "extent." The Panel therefore suggests that it may be appropriate to restrict the question in the final Report to just "condition of groundwater"
- See comments on the pesticides in streams indicator—they apply here, as well.

3.3.3 Discussion

- There is a dire need for a national monitoring program to address groundwater extent; this is within the domain of the USGS and hopefully funding can be obtained to start this work. In the interim, why not use groundwater contribution to stream base flow as a measure? Gauging stage data from appropriate streams across the nation might serve this purpose.
- 3-48/15: Changes in water table elevations are available in many groundwater basins. For example, California Department of Water Resources maintains the water table data. Over-drafting groundwater resources is a major concern and pressing environmental issue in the central and western states. Regional indicators should be developed to address the question of "extent."

Wetland Extent, Change, and Sources of Change

- 3-54/19: An important limitation of these data, which is not stated, is that extent does not equate to quality—the increase in freshwater ponds results in a very different quality of habitat than an increase in wetlands.
- If possible, the data should also be shown in the final Report by region within the U.S.

- Exhibit 3-19: More attention should be paid in the final Report to the "other" category; relative to the identified land use categories, this change in very large and cries out for better classification.

Trophic State of Coastal Waters

- The Panel recommends that in the final Report the water chapter indicator called "trophic state of coastal waters" be renamed "nutrients" or "eutrophication" in coastal waters. Trophic state is a larger concept that would encompass, for example, depleted stocks of large piscivores such as cod in New England that have altered food webs and the trophic state of the waters through top-down cascading effects. As written, the focus of this section of the water chapter is only on bottom up, nutrient-related issues. In future Reports on the Environment it would be useful to include considerations of the state of all trophic levels but the name of the indicator could be changed immediately.
- 3-62/2: It appears from the exhibits that this indicator does not include the Great Lakes coastal regions; this should be denoted in the final Report.
- 3-62/7: Note that algal blooms can also include attached, macroscopic algae, such as *Cladophora* or *Enteromorpha* blooms.
- 3-62/12: If the definition of algal blooms stays strictly planktonic, this sentence is correct as is; however, if it is extended to include benthic algae, then this sentence will need amending to reflect that reduction of chlorophyll *a* by filtering activity is restricted to water column chlorophyll *a*.
- 3-62/27: It may be instructive to include a table in the final Report that lists the reference conditions for each region; this gives readers an idea of the thresholds, and how they vary with region.
- 3-62/34: It does not appear that the composite U.S. score is weighted in any fashion. Is that correct? Given the very different lengths of coastal areas in each Region, what is the rationale for giving them equal weights?
- Exhibits 3-20 to 3-25:
  A) In the final Report, a more effective graphic display would be to show the regional map of the U.S. in the center of the Exhibit (now in the bottom footnote), and have each region blown up as a pie chart, radiating out from the U.S. map. The pie chart would show the four water quality categories.
  B) As noted earlier, ecoregions are a much more scientifically defensible geographic approach for showing regional data than EPA regions.
  C) There may be value in applying statistical tests to determine if there are differences among regions; one would need to know more about the data computation and distribution, a Chi-square test may work.
- 3-63/9: The indicator should be accurately defined in the final Report—this is dissolved inorganic nitrogen (DIN), *not* nitrogen, *per se*.
- 3-64/1: As above, in the final Report this should be called dissolved inorganic phosphorus (DIP), or ortho-P, not "phosphorus", which could mean a lot of different things to readers.

Dissolved Oxygen

- It is unclear when dissolved oxygen (DO) measurements were taken; because DO concentration is dependent on time of day, this point should be reflected in the discussion in the final Report.

Coastal Sediment Quality

- 3-67/2: It is unclear why this indicator was not applied to fresh water systems, as well. This does not invalidate its merit for coastal systems, but readers may wonder why there is an apparent inconsistency among systems.
- Exhibits 3-26 and 3-27: See comments above regarding 1) using a different graphic for these exhibits, using pie charts from each region emanating from a map of the U.S.; 2) revising composite U.S. score to weight based on coastline within each region; and 3) statistical analysis for differences among regions.

Coastal Benthic Communities

- Exhibit 3-28: See comments above for Exhibits 3-26 and 3-27.

SAV in Chesapeake Bay

- 3-74/2: In the final Report, EPA may want to generalize the importance of SAV beyond just Chesapeake Bay, similar to what is done for the introduction in the Hypoxia Indicator.
- 3-74/28: In the final Report, it would be useful, either here or in indicator limitations, to identify what percent of total area was estimated based on prior years' surveys for those years with incomplete coverage. Is this a small amount (<10%) or something more significant where the uncertainties have more significance?
- 3-74/32: The data show two distinct trends – increasing from 1984 to 1992 and leveling from 1992 to 2005. These trends should be discussed.
- 3-75/25: Species composition is also an important variable, as not all SAV species provide the same ecosystem functions.

Hypoxia in Gulf of Mexico and Long Island Sound

- This was a very well structured indicator.

HAB Outbreaks Along the Western Florida Coastline

- Other potential limitations to this indicator include: 1) cell density not necessarily equate to toxicity; and 2) biovolume may be a better indicator than density, although this may be too labor-intensive to compute.
- The selection of an indicator such as HAB should not be restricted to *coastal waters*; rather, the question is more appropriately aimed at surface waters—for future Reports on the Environment consideration should be given to reorganizing the questions in the water chapter around surface water (including both fresh and marine coastal), ground water, and drinking water.
- The HAB indicator is site specific. Perhaps the algal blooms are more common along the Florida coastline, but they are not unique to that region.

3.5.3 Discussion

- 3-84/28: In the final Report the "location of a large city" should not be characterized as a human *activity*—the Report on the Environment is confusing state variables and flows. This should be reworded to identify the relevant activities (e.g., runoff from impervious surfaces, combined sewer overflows, etc.).

Population Served by Community Water Systems (CWS) with no Reported Violation

- It is unclear why the indicator is not the inverse of what is presented—i.e., the number of CWS with reported violations. This seems the more direct measurement.
- 3-90/39: The value of reporting the number regions above the national percentage is unclear. Don't the regional data what makes up the national percentage? What is the point of including this information?

3.7.3 Discussion

- Why not have a regional indicator based on number of beach closings (number of beaches or number of days)? This information is currently being collected in the Great Lakes, as part of the EPA Beach Act.

Coastal Fish Tissue Contaminants

- Exhibit 3-38: See comments given above regarding 1) using a different graphic for these exhibits, using pie charts from each region emanating from a map of the U.S.; 2) revising composite U.S. score to weight based on coastline within each region; and 3) statistical analysis for differences among regions.

Contaminants in Lake Fish Tissue

- Exhibits 3-40/41: In the final Report, it would be more instructive to represent these data by Region to show geographic differences.
- 3-109/4: In the final Report, the absence of Great Lakes data should be noted earlier in this section, not just as an indicator limitation bullet. This is important given the historical legacy of contaminants in this region, so the exclusion of these data may result in an underreporting of the degree of contamination.

Land Chapter

Land Cover

- The Panel's issues of concern for the land cover indicator are that: a) the data are old, b) the classification categories for land cover are too coarse, and c) to date there is no time series (trend) information, though EPA reports that time series information is under development. There are a number of regional and national products; including the National Land Cover Data Set (NLDC), Landscape Fire and Resource management Planning Tools (LandFire), and others. These would provide greater resolution and time series for these analyses.
- The Panel recommends that in future Reports on the Environment, EPA consider using a range of land cover classification schemes with different levels of resolution based on what is most appropriate to answer specific questions.

- In the land chapter there is no discussion regarding the relationship between the status/trends in land cover and the effects on human health and the environment. In the final Report, it would be helpful to elucidate what data collection and analysis will be required to answer these questions and steps that need to be taken to make this a practical and useful indicator.

Forest Extent and Type

- The Panel believes that EPA needs to characterize land cover of all major ecosystem types. Therefore it is unclear why the Agency chose to only report on forest extent and type over other types of land cover. Other land cover types are distinguishable from existing imagery products data sets, the data presented for the land use indicator show trends in many different land cover (use) types. The rationale for only using forest extent and type needs to be clarified in the final Report.
- The forest extent and type indicator that is presented in Chapter 6 (ecosystem condition) only represents timberland. This presents only one category of forest land and others should be included in future Reports on the Environment.

Land Cover in the Puget Sound/Georgia Basin

- The land chapter regional example on Puget Sound using the National Oceanic and Atmospheric Administration Coastal Change Analysis Program (CCAP) data has very coarse classification information that translates to a low sensitivity indicator instrument. The reference point of 10% impervious surface becomes an important metric to make a statement regarding what the indicator means, whether things are falling apart or improving, and when action needs to be taken. There are many changes brought up in this section that may be better suited to the land use indicator category.
- There is no good explanation why the Puget Sound example was chosen to be representative of "land cover." Such an explanation should be included in the final Report. The area encompasses many watersheds that have many different types of land cover, but the data only assess changes to forest and urban classes. The example does not provide much useful information or methodology that would describe an approach that should be used for assessment of land condition outside of the immediate area covered by the case study. The Panel suggests that regional indicators should provide this use through inclusion in this Report. The Panel supports the inclusion of regional examples, but believes that they should present data or methods that can be applied across the U.S. An example or case study should be chosen to demonstrate particular aspects of the conceptual model underlying the set of indicators and their linkage to the fundamental questions.

Land Use

- The Panel suggests that in future Reports on the Environment, EPA evaluate and adopt widely-used standardized approaches to classify land uses that have been developed through the National Resource Inventory and the Forest Inventory and Analysis programs as well as the National Agricultural Statistics Service and Economic Research Service. The Panel finds that much of the introductory

material in the land chapter discusses the differences between approaches rather than interpreting what they can tell us about the status of land resources. The Panel is pleased to see that this indicator provides a beginning of a time series that can be used to document trends. The usefulness of the discussion will be improved by elaboration of what specific land uses changed from one class to another.

- The Panel notes differences between national and EPA regional data for land use in the Report. The discussion regarding the land use indicator is inconsistent concerning the inability to obtain data for land cover and the data available for land use. The land use data sets imply that there are trend data available for land cover. If this is not the case because the land use and land cover data are different in nature, this will need further explanation. For future Reports on the Environment the agency should work to adopt standard approaches for land use and land cover analyses. Standardized land use and land cover analysis and reporting at national and regional scales ultimately will benefit from a higher level of classification and mapping consistency across all federal agencies.
- For future Reports on the Environment, the Panel recommends that EPA consider adding road density (which can be measured directly just like stream density) as an indicator for land use. Accurate road density data are readily available in electronic, Geographic Information System (GIS) format (e.g., as Topographically Integrated Geographically Encoded Referencing System [TIGER] files). Since TIGER is a U.S. Census Bureau product, its limits and accuracy are well documented (http://tiger.census.gov/). Nationwide data are available, and changes over time can be mapped and measured. Density can be determined for specified regions of interest. There are other sources of road network data, but a 1990-2000 TIGER would be a good start.

Urbanization and Population Change

- The Panel finds that the urbanization and population change indicator in the land chapter presents much good information regarding the relationship between these factors. However, the chapter provides limited and indirect examination of the relationship between the available information and the resulting affect on human and environmental health.
- The Panel finds that the urbanization and population change indicator actually measures a stressor of land use in addition to one type of land use (developed land). The Panel questions whether population is a land use indicator or part of a group of indicators considered to be major drivers (stressors) of most indicators.
- In the final Report, the developed land data set that is used in the land chapter to represent urbanization and population change needs to be clearly described in the introductory text for this indicator. EPA should evaluate whether a more useful indicator might be "population density by land use type," not by EPA region. Exhibit 4-11 on page 4-33 shows population density in the U.S. by EPA Region but the EPA Regional averages do not capture the aggregation of population density. Data aggregation is a major issue and EPA needs to be cautious that this does not misrepresent the extent and intensity of environmental impact.

- The discussion for the land use indicator addresses human residential and commercial uses. The Panel suggests that more could be said in the final Report about other land changes (e.g., changes in agricultural land and associated fertilizer and pesticide use), beyond just identifying them as gaps.

Quantity of Municipal Solid Waste Generated and Managed

- The data used to represent this indicator are well defined and consistently collected. However, the connection to human health and the environment is missing and should be discussed in the final Report.
- In the discussion of indicator limitations it is stated that the available information is model driven. The Panel recommends that more information be provided in the final Report about sources of uncertainty associated with the modeled estimates. If the estimated waste generation is based on a model that uses materials utilized, these changes and thus the quality and quantity of the waste is not "consistent from year to year" as stated. The Panel also notes that this indicator does not appear to meet EPA's indicator acceptance criteria. The Panel does not recommend omission of the indicator, but more discussion of the quality of the estimate is needed in the final Report.
- In the discussion of indicator limitations, a gap concerning landfill capacity is identified. The Panel notes that landfill capacity is not a nationally limited resource (only cheap landfill space near some very large cities is in short supply). Therefore, landfill capacity should probably not be listed as a gap in the final Report.
- Some interpretation in the discussion of this indicator is not well linked to the data and should be avoided in the final Report. For example, on page 4-46 it is stated that, "Recycling efforts related to municipal solid waste have increased over the four decades showing the steepest increases between 1980 and 2000, most likely due to the increased awareness about the benefits of recycling and the implementation of policies by state and local governments tying waste generation directly to the cost of waste services."

Quantity of RCRA Hazardous Waste Generated and Managed

- The data used to represent this indicator are well defined and consistently collected. However, the connection to changing levels of exposure and the resulting impact to human health and the environment is missing and should be discussed the final Report. This is an indirect land use issue, especially when deep well injection is a major method of getting rid of the RCRA waste.

Fertilizer Applied for Agricultural Purposes

- There is good information presented in the land chapter discussion of this indicator, but it is again not related to human and environmental health. The "delta" between fertilizers applied, that taken up by the crops, and that which is released to the environment is the most relevant indicator.
- The Panel notes that this indicator is limited to three crops and questions how well it represents fertilizer application in cropping across the U.S. The Panel also notes that separation of data for this indicator by EPA regions could be helpful

since nitrogen and phosphorus drain into rivers, and large watershed regions might be more appropriate.

- The Panel recommends that a pesticide use indicator be added to the land chapter. Of the final Report. This could be done by renaming the indicator as "Fertilizer and Pesticide Applied." In this regard, one possible indicator that could be used is pesticide sales, which could likely be parsed into agricultural and residential/commercial landscape applications. The latter would provide a suburban/urban indicator, which is important from the standpoint of human exposure.

Toxic Chemicals in Production-Related Wastes Released, Treated, Recycled, or Recovered for Energy Use

- The Panel notes that the title for the indicator should perhaps be modified in the final Report so that it does not appear that only toxic chemicals related to energy use are being considered.
- Toxic chemicals have a direct relationship to human and environmental health; therefore any reduction in the release of these chemicals has net positive health benefits. The indicator limitations section clearly points out the gaps in our knowledge and reporting base. In the final Report, this indicator might be more appropriately placed in a section dealing with toxic and harmful chemicals.
- In the final Report it would be helpful to weight the amounts of toxic chemicals by toxicity (e.g., the un-normalized weights given in Exhibit 4-18 on page 4-55), but this is addressed under limitations.
- The Panel recommends that in the final Report indicator data (e.g., Toxics Release Inventory [TRI] derived) be included for persistent bioaccumulative toxics (PBTs) and mining wastes, even if the available data are limited, such as is apparently the case for PBTs. The Panel notes that PBT data are available for some aquatic ecosystems such as the Great Lakes. This indicator therefore provides an opportunity for integrating land the land and water chapters. The Panel suggests that EPA consult PBT data available in the draft 2007 State of the Great Lakes report (http://www.solecregistration.ca/documents/4201%20Contaminants%20in%20Sport%20fish%20(SOLEC%202006).pdf).

Pesticide Residues in Food

- The Panel notes that pesticide residues in food have a direct relationship to human and environmental health and any reduction in pesticide residue has net positive health benefits. However, the linkage of this indicator to land use is weak and the Panel recommends that in the final Report the indicator be moved to Chapter 5 (Human Health).
- The indicator limitations section clearly points out that we should be monitoring the detections that exceed established tolerance levels in addition to what our instruments are able to detect.

Reported Pesticide Incidents

- The Panel finds that the decline in reported pesticide incidents has a direct relationship with human health. However, the link between reported pesticide incidents and the human health impacts of land management practices is tenuous. Reported pesticide incidents cover all sorts of uses of pesticides, and are based on calls to poison control centers. Many of these incidents are related to misuse of household products and activities far removed from land management. The Panel recommends that in the final Report the indicator be moved to Chapter 5 (Human Health).

High Priority Cleanup Sites with No Human Contact to Contamination in Excess of Health-Based Standards

- The Panel finds that this indicator has a direct connection to human health and addresses whether people are being kept away from hazardous sites. It may be useful to include some RCRA Corrective Action sites in the analyses in the final Report. In addition, it may be useful to provide an indicator that would address the number of sites that have been taken off the high priority site list.
- The Panel recommends that EPA consider including in the final Report an indicator for the number and associated land area of sites of this type that have been cleaned up.

High Priority Cleanup Sites where Contaminated Groundwater is Not Continuing to Spread Above Levels of Concern

- The Panel finds that this indicator also has a direct connection to human health as it addresses whether contaminated waters are being contained. It would appear that there are many additional CERCLIS listed sites and other RCRA Corrective Action sites that could also be included in these analyses. It may also be useful in this case to provide an indicator in the final Report that would address the number of sites that have been taken off the high priority list. EPA should also consider including an indicator of the number and associated land area of sites of this type that have been cleaned up.

Human Health Chapter

Health Effects of Air Pollutants

- In describing health effects associated with air pollutants, authors should be careful to include in the final Report those effects associated with low-level exposure as occurs in the ambient environment. For example, ambient carbon monoxide is described as having effects including cardiovascular, neurological, visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty performing complex tasks. The Panel questions whether these effects are associated with low level exposures.

Ecological Condition Chapter

Need for Additional Indicators

- Indicators are provided in the ecological condition chapter to answer the question: "What are the trends in the diversity and biological balance of the nation's ecological systems?" The Panel notes that the concept of biological balance includes complex interrelationships for which clear indicators are not easily selected. Those indicators selected are either population states or events which are difficult to translate into "balance." Very few biological taxa indicators are included. At present, it is a good start but inadequate. Far more indicators of floral and faunal groups as well as biological communities should be included in future Reports on the Environment.

Ecosystems are Missing

- Western continental issues. In the ROE 2007 Science Report there is little or no attention paid to the arid ecosystems in the Great Basin and the desert southwest. Grassland/prairie, shrublands, rangelands, and chaparral are important ecosystems in terms of biodiversity. It is important to include information on these ecosystems in future Reports on the Environment.
- Coral reefs. Coral reefs have been in serious decline due to eutrophication, overfishing, siltation, disease, and climate, among other factors. Many of the factors affecting coral reefs are germane to EPA regulatory programs. Much monitoring data are available on these ecosystems. The Panel notes that earlier reviews recommended that coral reef cover, which had been proposed as an indicator, not be included in the 2007 ROE Science Report because it lacked calibration between methods, does not explain how sites were selected, and lacks a consistent analytical framework to adjust for bias in geographic distribution and sampling method. We think that, because of their ecological, economic, and recreational value, the benefits of including corals in the Report outweigh these problems. Many coral reef monitoring programs use transects, and data from these monitoring programs could be used in the Report. A regional coral reef indicator could be developed, using only those that reefs that were sampled appropriately. Problems with the data could be described in the limitations and gaps section. The Panel recommends that coral reef information could be added to future Reports on the Environment.
- Soil ecosystems. Soils are one of the key drivers that cut across all terrestrial ecosystems. Soil is a fragile and finite resource that plays a unique role in maintaining air and water quality. Use and management of native, agricultural, forested, range, and urban lands play an integral part in influencing soil and water quality within a watershed. Protecting soil quality is important for ecosystem productivity and water quality. Soil morphological, physical, chemical, and biological properties can serve as indicators. Spatial data in various ecoregions are currently available on range of soil properties and should be included in future Reports on the Environment.

Populations are Missing

- Marine/estuarine fish. The Panel recommends that in future Reports on the Environment, the ecological condition chapter include considerations of marine/estuarine fish populations. There are numerous long-term data on these

populations available from NOAA Fisheries. Many species are in decline due to overfishing; this has received considerable attention. The depletion of predatory fish can have ramifications through the food web via trophic cascades that can result in reduced numbers of grazers, and subsequent algae blooms, that can exacerbate eutrophication. The depletion of filter feeders such as oysters can also lead to reduced water quality. While fisheries are not EPA's responsibility, the depletion of upper trophic level species can have major effects on the ecosystem and environmental quality.

- Amphibians. The Panel recommends that in future Reports on the Environment EPA include in the ecological condition chapter an indicator dealing with amphibians. There have been many studies documenting the precipitous decline and loss of populations of amphibians, and some of those could be used to construct an indicator. While the reasons for the disappearance of amphibians are not all understood, some factors involved appear to be climate change, ultraviolet radiation, and pesticides, all of which are relevant to EPA. If development of a national indicator is not possible, a regional one could be developed.
- Invasive species. The Panel recommends that in future Reports on the Environment EPA include data on non-indigenous invasive species in a variety of terrestrial and aquatic ecosystems. There are numerous data sets that could be used to develop indicators, at least for some regions. For example, SERC (Smithsonian Environmental Research Center) has data sets for marine/estuarine invasive species. Additional sources of information are the Global Invasive Species Database of the Global Invasive Species Information Network (http://www.invasivespecies.net/), and the National Invasive Species Information Center hosted by the U.S. Department of Agriculture (http://www.invasivespeciesinfo.gov/).
- Taxa containing massive diversity. The Panel recommends that in future Reports on the Environment indicators be developed for taxa such as microflora and microfauna, and non-vascular and vascular plants, which have very high biodiversity. Ecosystems host complex microbial communities, including bacteria, fungi, protozoa, and viruses. The size and diversity of microbial communities are directly related to quality and quantity of resources available. Microbial processes and populations have more rapid turnover than higher trophic levels and are often more responsive to environmental change. These characteristics make microbes good indicators of ecosystem condition because they are potentially very sensitive to perturbations such as nutrient loading, hydrologic alterations, and fire. New information is now emerging about these indicators and the Panel hopes this information will be added in future reports.

Processes are Missing

- Denitrification. The Panel recommends that in future Reports on the Environment the ecological condition chapter include an indicator of the natural denitrification process which is important for nutrient balance in ecosystems, for example, the denitrification of nitrate from atmospheric deposition. Ecological processes in low order streams are important in processing excess nutrients (e.g., denitrification of N from atmospheric deposition).

- Soil processes. Another issue of importance is the trend in the extent and condition of the nation's soil resources. As noted above, soils are one of the key drivers that cut across all terrestrial ecosystems. Soil quality and associated processes can have major influences on ecosystem productivity and nutrient cycling. Loss of topsoil due to erosion and other processes can influence ecosystem productivity and long-term assimilative capacity as well as stream water quality. Assimilative capacity is important as ecosystems have finite capacity to provide services before they are drastically altered. For example, long-term application of nutrients via fertilizers or organic wastes may ultimately saturate a system. This is evident through accumulation of phosphorus in soils and increased levels of nitrate in ground waters. Salination of irrigated farmland soil is an urgent issue in the arid Southwest. Potential soil quality indicators include: carbon storage, organic matter, nutrient inventory, phosphorus index, extent and soil type, soil quality, salinity, soil erosion. The Panel recommends that future Reports on the Environment consider these indicators.
- Acidification. The Panel notes that there are long-term data sets available on responses to acidification and its reduction (National Acid Precipitation Assessment Program [NAPAP]) that should be included in future Reports on the Environment.
- Disturbance. Disturbance is a critical process in all ecosystems and should be included in future Reports on the Environment. The Report discusses its importance but has no indicator of disturbance or response to it (e.g., resilience). Disturbance processes can be used as indicators of anthropogenic effects on the environment. For example, maps showing how fire cycles have changed in relation to the health of forests can provide important information on a critical issue

Trends in Diversity and Biological Balance of the Nation's Ecological Systems

- On page 6-29, the final Report should acknowledge that some systems inherently have different numbers and variety of species, making it inappropriate to make comparisons among systems.

Choice of Forests, Wetlands, and Land Use as Indicators in Chapter 6

- While there is nothing wrong with these categories, it is unclear to readers why these were chosen and not other equally appropriate categories. A conceptual framework would be very helpful in the final Report to place these categories and indicators into some type of context.

Forest Extent and Type

- This indicator is limited to "timberlands" which is misleading. This is nearly equivalent to using corn and wheat fields in order to describe the extent of grasslands. The Panel notes that this indicator is based on productive capacity, and therefore a statement in the Report concerning the limits of indicators that have excluded production does not apply. However, the discussion of indicator limitations does recognize some of the limits of using timberland data.

- 6-16/15: What percent of forest land is not being captured in this analysis? In the final Report this percent should be explicitly noted as part of the uncertainty.

Forest Fragmentation

- The Panel understands the value of using forest fragmentation as an indicator but questions why a fragmentation indicator is not equally important for the other ecosystems. The Panel questions whether this is because of the availability of data. The Panel finds that in the final Report, a schematic diagram graphically showing the four degrees of forest cover to complement the narrative would be helpful, as would a presentation of the absolute area of forested lands identified for each region.

Wetland Extent, Change, and Source of Change

- Development of artificial wetlands, ponds etc. may skew data for this indicator.

Ecological Connectivity (Region 4)

- The Panel notes that development of this indicator is an exercise demonstrating how to show connectivity, but since it is regional it does not tell much about connectivity either nationally or in major ecoregions. The distinction between hub and corridor should be better defined and shown in the map in the final Report. If the methodology is relatively simple and uses just National Land Cover Data Set (NLCD) data, then a major effort should be made to see if it is applicable to non-forested regions.

Relative Ecological Condition of Undeveloped Land (Region 5)

- The Panel finds that this is a case where a tool has been developed for one EPA region but it does not tell the story about the landscape in general or its usefulness. The indices used have the potential to display a lot of information, but it is not stated what exact data layers are included in each index. This tool used only NLCD data to generate three indices, two of which use species diversity or rarity. The Panel questions whether it is possible to go to species level with NLCD satellite data. If models were used for the diversity and rarity indices, they should be explained. In the discussion in the final Report it should be noted that increases in developed land affect habitat and impact physical and chemical processes such as runoff from impervious surfaces, reduced groundwater recharge, and increased stream temperatures.
- Shades of green are extremely difficult to distinguish in Exhibit 6-8.
- Undeveloped is a relative term and appears to be confounded with population density, making it inappropriate to draw conclusions or causative associations (as on page 6-27, "The potential for future land use changes with increasing urbanization is the major determinant for judging potential fragmentation of ecological systems in EPA Region 5…")
- In the final Report EPA should clarify the interpretation or importance of the cover types mentioned: maple-beech-birch, spruce and pine. Is this simply a

descriptive statement or should the reader be able to infer something about a trend of ecological significance?

6.2.3 Discussion

- It is unclear why forests, wetlands, and land development, of all available indicators, are the three worth highlighting for the nation's ecological condition. This should be clarified in the final Report.
- 6-27/1-3: It may also be worth noting that these increases in developed land affect not only habitat loss for biota, but also impact physical and chemical factors, such as more runoff from impervious surfaces, leading to greater loading of nutrients and contaminants, a more unstable hydrology, reduced groundwater inputs, and increased stream temperatures.

6.3 Discussion

- 6-30/25-31: It is helpful to know about the absence of a systematic biodiversity initiative in the U.S., but there is still a need to explain in the final Report the rationale behind including those indicators that are found in the Report.

Bird Populations

- The limitations on the data set should not detract from the usefulness of this indicator. It is one of the more consistent, long-term sets of ecological measures in the whole Report.
- In the final Report, EPA may want to qualify in the text in the data bullets to note that the significant increases or decreases are of observations, not population size.

Fish Faunal Intactness

- The discussion in the ecological condition chapter states a concern over the inability to show magnitude of loss. The Panel notes that this could be remedied by using a map of number of species lost. With such a small number of species to begin with, the percent decline figure can be misleading. The Panel questions whether using 1970 as a reference year potentially confounds comparisons from regions that were heavily polluted at that time. The Panel recommends that data from estuarine fish should be included in future Reports on the Environment.

Non-indigenous Species in the Estuaries of the Pacific Northwest

- The limitation one area implies that non-indigenous species are less important in other estuaries. The Panel notes that the restriction to species captured in a grab sample suggests that this is how most invasive species can be sampled. However, this is not true. More estuarine invasive species tend to be epibionts that attach to surfaces. Some invasive species cause greater disruption of ecosystems than others, so it may make sense to use indicators that address those species that are most ecologically or economically problematic. The Panel finds the preliminary classification of estuaries as "exposed" or "background" depending upon the assumed amount of ballast water or aquaculture releases is naïve, since estuarine biota disperse, and currents aid their spread, particularly in the planktonic stages. There is no need to pre-classify estuaries. Once the data on non-indigenous

species are collected, then estuaries can be classified according to their percentage of non-indigenous species. The Panel recommends that in future Reports on the Environment this indicator be expanded to other estuaries as well as other aquatic and terrestrial ecosystems.

6.3.3 Discussion

- 6-40/18: Chesapeake Bay SAV may not be a representative example for wider-spread phenomena.
- 6-40/24: It may not be possible to statistically defend this claim with the available data sets.
- Good regional long-term data sets may be available to address above ground plant richness and diversity (e.g., Long-term Ecological Research Programs, Harvard Forest data)
- 6-42/25: Perhaps a useful template for the type of exhibit on this page would be a map of the U.S. subdivided into regions, with more detailed maps of each region showing data for different representative species. For invasive species, this may be an autotroph or a heterotroph, or aquatic vs. terrestrial, depending upon which species provides the best information for the region.

6.4 Discussion

- Perhaps the Midwest Environmental Advocates (MEA) model could be used for identifying ecological processes that sustain the nation's ecological systems (i.e., provisioning, regulating, cultural, and supporting).
- There is a fundamental problem in the indicator chosen for this question. The question deals with processes, but the indicator deals with a state variable, not a process. This can be resolved by changing the question or choosing an indicator that answers the question, such as primary productivity, decomposition rates, or nutrient uptake/cycling rates. Long Term Ecological Research Program sites should provide a rich source of data for these types of information.

Carbon Storage in Forests

- The Panel notes that carbon storage in forests is not an ecological process *per se*, but a condition representing the net balance between the processes of photosynthesis and decomposition. This indicator can show trends. However, many more processes need to be covered in future Reports on the Environment. The use of several geographic regions is more logical here than the use of EPA regions elsewhere. Unfortunately, the data in the chapter represent only "timberlands" which include many highly managed forests and this should be pointed out in the limitations section. Use of this indicator should be expanded in future Reports on the Environment to carbon storage reservoirs, such as grasslands, especially below ground (soil) storage which holds a significant portion of the total carbon.

Photosynthesis and Decomposition

- Photosynthesis and decomposition are the two most important ecological processes. Carbon storage is described as an indicator representing the net

balance between these two processes. Restricting the indicator to forests and excluding grasslands greatly weakens this indicator. In the final Report this needs to be discussed in the limitations section on page 6-46.

6.4.3 Discussion

- 6-48/4: The indicator does not provide data on trends in primary production; this process is a rate. The indicator provides data on a stock, which is different.
- 6-49/1: Another limitation, assuming carbon storage is used as the proxy indicator for this question, is that carbon storage from many other important terrestrial ecosystems is missed.

U.S. Temperature and Precipitation, Sea Surface Temperature, Sea Level

- These are very good time series data. They are all physical attributes that have impacts on biota and on ecological processes. These indicators, and their links to greenhouse gas emissions discussed in the air chapter, should be included in the ecological condition chapter discussion in the final Report.

Sea Surface Temperature

- 6-59/4: Why not include statistical information?

Sea Level

- Although not technically "sea" level, one limitation is the lack of data reported for Great Lakes levels. These data are available from the U.S. Army Corps of Engineers (Detroit District), and should be considered for inclusion in future Reports on the Environment.

Appendix B: Editorial Comments

General

- Throughout the Report there is generous use of acronyms, which may be confusing, but perhaps unavoidable. Thus, including a list of acronyms and abbreviations (e.g., units of measurements) would be an improvement.
- As this version of the Report is intended for scientists rather than the general public, it would be helpful to use metric system units throughout for measurements (e.g. ^{o}C rather than ^{o}F for temperature).

Introduction

1-4: Identify explicitly the philosophy behind choosing indicators.

Water Chapter

3-7/14: Replace "like" with "such as".
3-7/42: Move "only" to after "meet".
3-9: Should N and P discharge be load?
3-9: Delete "wetland extent…" from the coastal waters box.
3-11/37: Seems that NPS paragraph also should include affects of land cover, such as impervious surfaces.
3-12/1-3: Air deposition should include nutrients, as well (N and P)
3-12/12-18: It is not just extent of the fresh waters, but also their configuration in the landscape that matter. This should be noted.
3-15: Exhibit 3-1: Clarify caption: "Relative percentages of rivers and streams in terms of their changes of high and low flow …"
3-17/3: Are any estimates available of the percentage increase of dammed rivers between 1949 and 1970?
3-26/10: Suggestion--briefly explain the weighting scheme used.
3-28/24: Change to "have a broad geographic distribution".
3-36: Needs enumeration of rows 1-45.
3-42/19: Add: Groundwater accretions in agricultural watersheds may also increase contaminant loads of rivers and streams.
3-50/17: This is not a *location* classification—it is salinity of media
3-53/4: Insert "and other types of coastal" after 'Estuarine'
3-53/7: Insert ', chemical' after 'biological'.
3-53/14: Insert "These conversions reduce the area of the relatively unique systems such as forested swamps and bogs and increase the area of the ubiquitous ponds and marshes." after "pond."
3-54/19: Insert "although still much less in absolute terms than the other wetland types" before "Panel D".
3-54/40; 3-55: Exhibit 3-19--Please clarify the meaning of describe the process of "deepwater conversion".
3-57: Insert "and continue to be lost" after "1990s".

3-57/29: Insert "and some wetland types such as forested swamp and bogs are difficult or even impossible to create or restore." after "lost".
3-57/32: Insert "using a logistically plausible" after "estimate" and Remove "without an impractical".
3-58/3: Insert "function and" before "condition".
3-63/9; Exhibit 3-21: Include quantitative information for nitrogen concentrations.
3-64: Exhibit 3-32: Include quantitative information for phosphorus and chlorophyll.
3-67/3: May want to define what is meant by "adverse".
3-71: Exhibit 3-28 is missing letters and a dash in the label within the text box.
3-79: Exhibit 3-32 is missing data in Panel A.
3-71: Exhibit 3-38--Fix caption number.
3-72/19: Address the possible effect of the weighting scheme and methodology on the results.
3-79: Exhibit 3-32--- Include missing data in graphic.
3-82/6: Limitations---the temporal trend is limited by the short time span (only 5 years of data).
3-84/30: Comment---How much different? Many times higher or less?
3-87/5: Suggestions---Include brief definitions of surface water and ground water.
3-103/17: Suggestion---Include brief description of health risk basis of guideline.
3-104: Exhibit 3-38---Indicate that the values are percentages. Add: "Percent" to caption.
3-108/10: Briefly explain toxic equivalents (TEQ). MDLs have no direct relations to health risk.
3-109/2: Comment---Imported seafood accounts for 70% of consumption. Perhaps it is also an FDA issue.

Land Chapter

4-61: Consider an outline to the bars in Exhibit 4-6, 4-7 (pp. 4-26, 4-27) to make them more visible, such as in Exhibit 4-23.
4-31: legend is incomplete in Exhibit 4-8
4-50: NPK are identified as pounds per acre; are these the desired units?
Are these values devoid of inert ingredients (i.e., just element)?

Human Health Chapter

5-7: Figure 5-1 can be enhanced by depicting susceptibility factors including genetics, diet, etc. described in the paragraph starting on line 28 of page 5-6. Furthermore, this figure might more effectively appear within the introduction as a way to provide both a conceptual framework for the Report on the Environment as well as the organizing principle. The figure and text would need to be modified to include ecological effects and to show increased uncertainty as indicators move from left to right.
5-7 and 5-8: In the introduction, terms such as definitive proof" and "conclusive evidence" are used. It might be better to omit the adjectives.

Ecological Condition Chapter

6-14: In Exhibit 6-2 add black outline bars to make it easier to see light colors.
6-14: In Exhibit 6-2, indicate the percentage changes rather than absolute changes because forest coverage and sizes differ from region to region.
6-15: Clarify that emphasis in Exhibits 6-3 and 6-4 is on economically important species.
6-15: In Exhibits 6-3 and 6-4, indicate percentage changes rather than absolute changes because covering and sizes differ from region to region.
6-18: On line 13 explain "degree of connectivity." Can a quantitative definition be used?
6-21: In Exhibit 6-6, a different color scheme should be used. The map does not show clearly the difference in the greens.
6-22: On lines 22-24, please specify the twelve layers and the four layers if possible. Are any weighting factors used?
6-25: On line 15 clarify "decreases in Regions 6 and 9" and "increases in Regions 3 and 5." The data in Exhibit 6-2 show discrepancies from the general statement in the text. Region 9 has increased during 1977-2002.
6-30: Insert acknowledgement that nutrient enrichment can also be considered a "pollutant" and be responsible for community shifts toward invasive species.
6-30: On line 1 the following suggested change in the wording is provided: "…by global events such as large meteor impacts…" or …"bolide collisions..."
6-32: With regard to bird populations, delete the following debatable statement, "are among the most visible and important biological components of ecological systems and"
6-32: Note whether abundances in Exhibit 6-9 are standardized by numbers of observers.
6-32: On line 22 discuss the possible causes for the decrease in grassland species.
6-34: With regard to fish faunal intactness, explain why 1970 is chosen as the reference.
6-35: Expand the legend in Exhibit 6-10 to explain the pie chart (i.e., reduction areas expressed as % total land area).
6-37: On line 12 replace ">=" with "≥".
6-38: In Exhibit 6-12, illustrate where the "exposed" and "minimally exposed" estuaries are located on the map and provide an idea of the sampling intensity.
6-40: On line 24, the following statement needs supporting data and justification: "…fewer blooms in recent years as compared to 1996…"
6-45: The key in Exhibit 6-13 is missing the color codes. Letters are missing in the title of the exhibit.
6-45/32: The word "somewhat" understates the trend. Inspection of the data indicates a decline in the 1990's of approximately 33%, which is more substantial than "somewhat."
6-46: In Exhibit 6-14, indicate in the captions and on the labels that the values are net changes of storage, not total storage.
6-46: On line 31, can an estimate of carbon storage (e.g., % of total) in soils be provided? How significant is this omission?
6-46: In Exhibit 6-14, add outlines to fill in order to increase the visibility and acknowledge that the net carbon storage is affected by climate and soils.
6-48: On line 9, the dates in the discussion do not correspond to the dates presented in the indicator.
6-49: On line 2 include estimates of carbon storage in soils.
6-53: On line 41, what is the confidence level or statistical significance of the regression?
6-54: In Exhibit 6-16, add negative signs on the temperature scale.
6-55: On line 14, include the names of the three climate regions.

6-56: In Exhibit 6-18, the graphs as presented do not clearly show support for the discussion. Please modify the graphic data to show statistical significance.
6-56: In Exhibit 6-18, the Y axis scales should be changed to appropriate values to better show trend data.
6-57: On line 2, a limitation should be added indicating that the empirical debiasing models used to adjust the data may themselves introduce non-climatic biases.
6-61: On line 33 the following change in wording is suggested: "subsidence or uplift caused by tectonic movements of landmasses." Delete "changes in natural land accretion."
6-64: On line 6, the following change in wording is suggested: "…due to changes in sea level or land elevation caused by tectonic movements."

Appendix C: Example Conceptual Framework

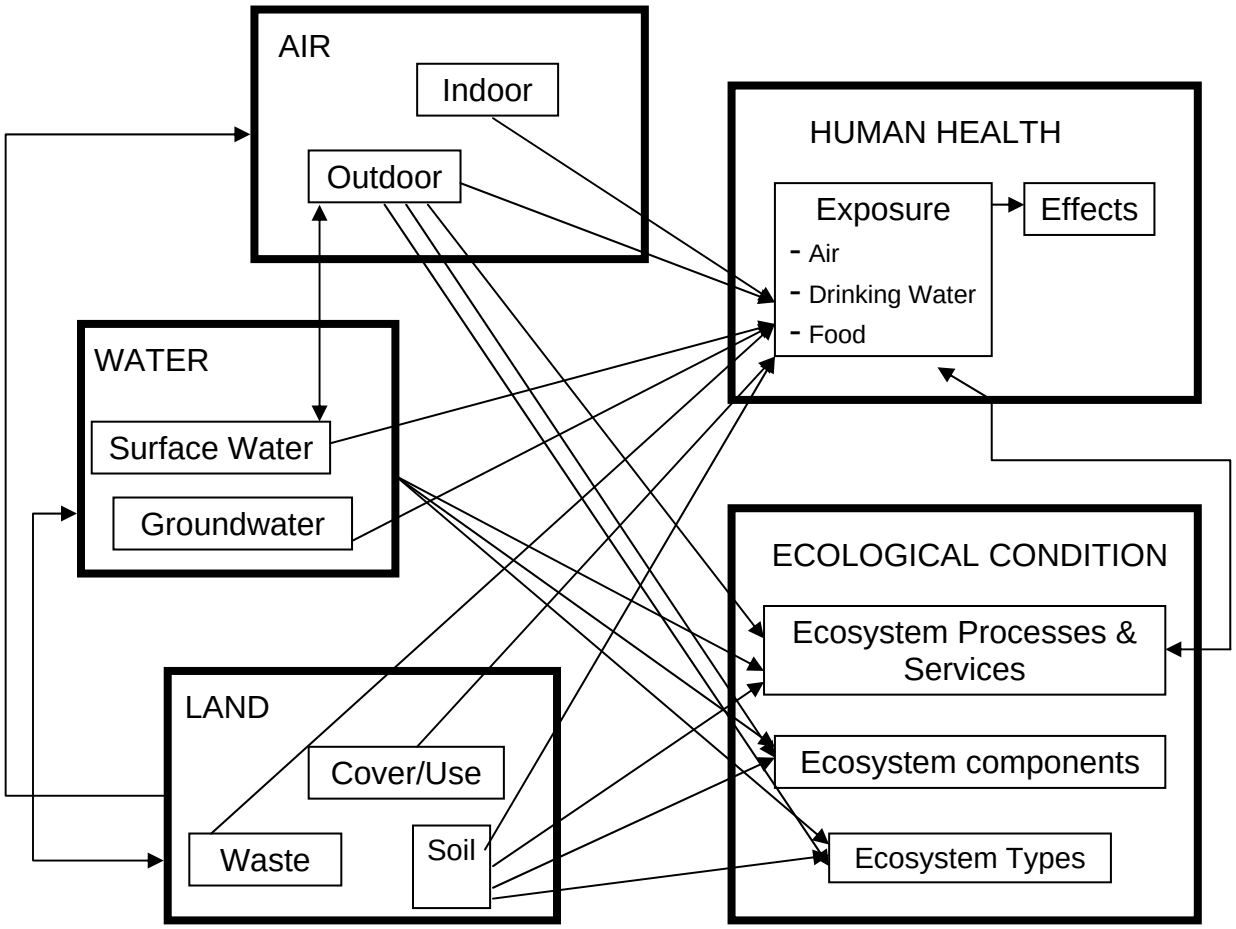
A synthesis chapter is needed to pull together the findings of EPA's Report on the Environment. The findings reported through the questions and indicators show status and trends of many different environmental parameters. These parameters have been placed in two types of chapters: 1) media (i.e., air, water and land), and 2) health and ecological condition. However, it is important to indicate that parameters are linked through attributes and processes that control the parameters as well as attributes and processes that the parameters influence. Consequently, to demonstrate the integration and synthesis of the Report, three components need to be added 1) a conceptual framework, 2) a synthesis discussion, and 3) a simple and clear description of each indicator, with a discussion providing a rationale of why it was selected, and what it should tell. It is recommended that the conceptual framework and the description of each indicator be added to the final Report, and the synthesis chapter be added to future Reports.

Conceptual Framework Component: We suggest that this be included as part of the suggested introductory chapter and possibly part of the introductions to the human health and ecological condition chapters. An example conceptual diagram is shown in the accompanying figure, which has the compartments of air, water, and land, and shows their connection to each other and their impacts and linkages to human health and ecological condition through physical, chemical and biological processes. Any such diagram that EPA develops for this purpose should show the flows, influences or connections among the many parameters selected to be used in the ROE 2007 (see figure). The figure is provided as an example. A more specific and detailed conceptual framework could be developed to represent relationships among indicators and media.

Synthesis Discussion: A discussion of the interactions among the many parameters selected to assess the state of the environment should include a commentary on the importance of status and trends of selected parameters within a particular medium. The commentary should draw upon the discussions of importance within each indicator text, and how these might influence each other as well as status and trends of parameters in other media. This cross media discussion then should demonstrate how status and trends in media parameters might influence status and trends of parameters within the integrative chapters (human and ecological health and/or condition). The status and trends within the human health and ecological condition chapters should each be discussed to describe the importance of the findings relative to "well being" and/or "sustainability" of each attribute (i.e., humans and ecosystems). The synthesis discussion should not put values (e.g., good, bad, inconsequential) on status and trend data but rather focus the discussion on the importance of the magnitude or "direction" of the status or trend and its implications for other factors.

Importance of Indicator: Each indicator should have a clear explanation of why it is important based upon a scientific (perhaps conceptual) fundamental understanding of drivers and processes that if changing will alter the status of the indicator over time. An example indicator description is provided in Appendix D.

Example Conceptual Framework Diagram



Appendix D: Example Indicator Description

The indicators should all have a consistent description and presentation to the reader. We recommend that each indicator have a description and/or definition of the indicator, and a clear justification and explanation for its selection. Secondly, we recommend that each of the metrics used to report the indicator be described. The following example is based on information contained in the SAB report, a Framework for Assessing and Reporting on Ecological Condition (U.S. EPA Science Advisory Board, 2002)

Example indicator: Landscape Condition

Landscape is an area composed of a mosaic of interacting ecosystems or habitat patches. A change in the size and number of natural habitat patches, or a change in the connectivity between habitat patches, affects the probability of local extinction and loss of diversity of native species, and can affect regional species persistence. At the landscape scale, the extent of broad land cover classes (e.g., forest, agriculture, urban/suburban, surface waters) can serve as surrogates of habitat extent for broad classes of species.

Landscape indicators are reported in the following three categories: extent of ecological system type, landscape composition, and landscape pattern/structure. The extent of ecological system type is an important indicator because it is correlated with species decline. Landscape composition information provides insight into long-term population viability because populations are unlikely to persist in landscapes where the largest patch of habitat type is smaller than that species' home range. Landscape pattern and structure provides a measure of habitat fragmentation that may isolate vulnerable species restricted to specific habitat types.

Metrics used to measure the indicator:

- Extent of the ecological system/habitat type: (e.g., habitat area, perimeter-to-area ratio, core area, elongation, etc.)
- Landscape composition: (e.g., number of habitat types, number of patches of each habitat, size of the largest patch, presence/absence of native plant communities, measures of topographic relief, slope, and aspect, etc.)
- Landscape pattern/structure: (e.g., dominance, distance between patches, longitudinal and lateral connectivity, juxtaposition of patch types, width of habitat adjacent to wetlands, etc.).

Appendix E. The Use of Ecoregionally Derived Indicator Information for Action and Decision Making at the EPA Regional Offices

All indicators need to be developed, analyzed and reported within an appropriate ecoregional context. This context includes important dimensions of scale and boundary, and must be driven by the intended uses for the indicator information. The formulation of the indicator parameters will be constructed from knowledge regarding their relationship to regional-scale ecological processes. The mapping of indicator values will be dictated by the amount of relevant data available for spatial analysis.

Environmental protection and resource management agencies are administered through hierarchical regional structures. These regionalizations are agency specific, and were developed through a complicated historical set of administrative and mission driven factors. Knowing that many environmental management and protection actions will be implemented by the regional offices, it is a common error to use these administrative regions as a surrogate for ecoregions for all ecological indicators. These administrative regions often do not represent the boundaries of resources that are being protected and managed by the Agency. These administrative regions should not be used as a framework for indicator analysis.

A two-step process is required to use environmental indicators to inform priority management and protection actions within an administrative region. First, the indicators must be developed within an appropriate ecoregionalization framework, and the analytical results must be generated for each indicator within each ecoregion in that framework. Second, the indicator results must be spatially parsed to provide relevant management directives to the regional offices.

As an illustrative example, let us consider the use of freshwater mussels as an indicator of water quality factors and biological intactness. The current distribution of mussel species represents a combination of hydrological connectivity, geochemical, land use and pollution factors. The logical ecoregional context for this indicator would be a hydrologic watershed framework that is represented at an appropriate scale that captures the relevant geochemical regimes and associated land-use patterns. Time series data on the composition and distribution of these species within these ecoregions relative to land use, exotic introductions and pollution sources would provide the desired indicators of ecological health.

Any administrative region could contain either entire watersheds or parts of watersheds. When a watershed is completed contained in one regional jurisdiction, that region would take responsibility to respond when the indicator demonstrates the need for intervention. When a watershed is shared by multiple jurisdictions, a decision must be made to lay out a formula for a) responsibility sharing, or b) designating full responsibility for management and protection decisions across the entire watershed to a particular administrative region. The designation of full responsibility could either be

based on the relative percentage of geographic intersection between watersheds and administrative regions, or by capacity and expertise factors within the different administrative regions. The critical point is that responsibility must be assigned and accepted to ensure the appropriate management response.

Appendix F. Table of Recommendations to be Considered Before Finalizing the 2007 Draft Report

Table F-1 in this appendix presents a summary of recommendations to be considered before finalizing the 2007 Report. The second column of the table provides page numbers where recommendations may be found this advisory report. Additional comments and suggestions are provided in the text of the report. Detailed comments pertaining to specific indicators are included in Appendix A.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Overarching	4	The introduction should be revised to clearly indicate that the first three chapters address status and trends using specific indicators for the individual "media" of air, water, and land, and that the next two chapters are syntheses that provide integrated assessments of status and trends in human health and ecosystem condition.
Overarching	4	The introduction should clearly state its purpose for intended audiences and EPA. The introduction should discuss how the Agency plans to use the Report and its analyses, and how the Agency wants the Report to be used by the broader public. In this regard, the Report should state that it provides status information to establish baselines for reporting future trends, but does not provide long-term trend information for many indicators.
Overarching	5	EPA should incorporate a conceptual framework into the introduction to illustrate the connectedness between the media, human health, and ecological condition chapters.
Overarching	5	In appropriate places of the final Report, interconnections between the indicators should be established by cross-referencing the discussion of indicators in different chapters.
Overarching	7	All questions should be broadened to ask "What are the status and trends…" rather than focusing only on trends.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Overarching	7	EPA should explicitly state how each question in the Report is related to a conceptual framework.
Overarching	7	EPA should provide a clear description of why each indicator is important, the rationale for selecting the indicator, what it tells, and the documented relationship between the indicator and human health and ecological condition
Overarching	8	Additional indicators (identified various sections of this report) should be included to show the response of more integrated components of the system or address missing issues. For example indicators should be included to capture the status of and trends in ecosystem services.
Overarching	9	EPA should identify the status of the monitoring programs (e.g., extant, "on hold," or expired) that have provided indicator data used in the Report.
Overarching	8	Additional trend data (classified as either qualitative or quantitative) should be included for as many indicators as possible.
Overarching	9	EPA should clarify whether specific bullets in the indicator limitations sections refer to indicator limitations or data gaps.
Overarching	10	The discussion of gaps and limitations should be expanded to identify some of the more prominent available data sets that were excluded and the reasons for their exclusion (e.g., technical concerns, lack of statistical power, or other specific reasons).

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Overarching	10	The discussion of data gaps and limitations should be strengthened by adding or expanding existing information in several areas. These include: 1) Discussion of the need for a transparent set of indicator metrics that can be well justified. The current choices of metrics and benchmarks are not well justified. 2) The need to provide additional information on emerging issues such as chemicals of emerging concern, exotic wildlife diseases or invasive species (the emerging issues should be discussed at the end of each individual chapter). The Panel specifically notes that perfluorinated chemicals should be added to the list of emerging contaminants of importance in Chapter 7 of the ROE 2007. 3) Further justification and discussion of limitations associated with the intervals of time used to establish trends.
Overarching	10	The implications of each indicator limitation should be discussed, and the uncertainties associated with each limitation should be quantified to the extent feasible.
Overarching	11	If EPA administrative regions continue to be used as the basis for regionalizing data, the Panel recommends that this process be better explained.
Air	15	A science framework should be incorporated into the air chapter of the final Report to show the interaction within, between and among media as well as between and among indicators.
Air	15	A short historical section should be added to the air chapter to provide background information on the criteria pollutants.
Air	15	SO_2 concentration should be added to the air chapter as an indicator.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Air	16	An air toxics indicator should be added to the air chapter.
Air	16	A broader explanation of what is in the National Emissions Inventory (NEI) should be added to the air chapter.
Air	16	Further analysis of the trends in air indicators should be added to the air chapter. While it is important to know whether air indicator trends are increasing, it is important for the reader to understand the reason for the direction of indicator trends. The Report should state where have we been, where we are now, and where we are going.
Air	16	An indicator should be added to the air chapter to focus on the clear reduction of primary pollutants (CO, SO_2, and Pb) but much flatter trends in secondary pollutants (O_3 and $PM_{2.5}$), reflecting the growing importance of secondary air pollutants.
Air	17	A small section should be added to the air chapter to discuss how climate change is affecting aerosols.
Air	17	EPA should acknowledge and discuss the limitations of a single pollutant, local source approach to pollution control in the context of the marked reductions in individual pollutants documented by the indicators, and as exemplified by continuing challenges with regard to ozone and PM2.5.
Air	18	EPA should view the PM speciation network as the vehicle to provide the needed information on PM composition.
Air	18	The bias that may result from the choice of base year for trends for a given air indicator should be discussed, as this has implications in the interpretation of the air indicator data.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Air	18	The effects of trends in ambient concentrations of air pollutant indicators on exposure and dose should be discussed.
Water	19	The questions in the water chapter should be expanded to focus on the interconnectedness of different systems (both within the different water types and across media).
Water	19	Additional questions should be included in the water chapter to incorporate missing information on availability and usage of water for human activities, especially with respect to both ground water and surface water withdrawals (see data in Roy et al., 2005 and Solley et al., 1995).
Water	20	EPA should examine the relevance of measures of "Extent and Condition" across all aquatic ecosystem types. In this regard, the Panel finds that the question on the "extent" of coastal waters is not meaningful because for coastal waters, the issue of importance is their condition not their extent.
Water	23	Data for the indicator "pesticides in agricultural streams" should not be compared to human health benchmarks.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Land	29	EPA should consider the following suggested revisions of the land chapter questions in order to improve their clarity. 1) The Panel suggests that trend information be developed wherever possible, and that EPA use both qualitative as well as quantitative data to generate trend information for all indicators. 2) The waste deposition addressed in Question 3 (wastes) could be considered a "land use" issue and included as a subtopic of Question 2 (land use). 3) The topic encompassed by Question 3 has overlap with the fundamental question regarding groundwater in Chapter 3, and there is a need for an explanation of integration among components of the Report in the introduction. 4) The agency may wish to list agriculture explicitly as the focus in Question 4. An alternative would be to include agricultural land indicators under Question 2 (addressing land use), considering agriculture as a specific land use. 5) The factors distinguishing Question 5 (addressing contaminated land) from Questions 3 and 4 should be explained more fully.
Land	31	EPA should include more direct indicators of effects in the land chapter.
Land	31	EPA should consider adding indicators for mining wastes, and wastes applied on agricultural land (biosolids, compost, etc.)
Land	31	EPA should add an indicator based on the generation and disposal of civilian radioactive waste.
Land	31	A pesticide use indicator should be added to the land chapter.
Land	31	The reported pesticide incident indicator should be moved to the human health chapter.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Land	32	The discussions of the data gaps in the land chapter should be modified to make it clear that the gaps mentioned are the highest priority gaps determined by the agency, and that the list is not intended to be comprehensive.
Human Health	33	The questions within the human health chapter should be reordered to be consistent with event sequence in the environmental health paradigm as depicted in Figure 5.1 of the Report (i.e., exposure precedes the health effect).
Human Health	34	The human health chapter should be more descriptively renamed as "Human Exposures and Health." This change is needed because the questions contained within the chapter encompass both human health and exposure.
Human Health	35	If credible quantitative impact estimates are available (e.g., estimates of the mortality impacts of particulate air pollution in selected locations in the U.S.), they should be included.
Human Health	36	The discussion of gaps and limitations should be expanded to include a more quantitative description of the indicator's relevance by relying on the epidemiologic literature.
Human Health	36	The concept statements in the indicator limitations sections such as "the measurement of mercury or any other environmental chemical in a person's blood or urine does not by itself mean that the chemical has caused or will cause harmful effects in that person" should be removed from each discussion of indicator gap and instead be placed in the conceptual framework section of the chapter.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Human Health	37	EPA should build on the higher geographic resolution theme by presenting individual or multiple state data which could inform the gross national estimates presented and point toward the future. This should be done if possible, given the time constraints of revising this version of the ROE.
Human Health	37	Bullet #2 on page 5-5 should be rewritten to include biological agents. The following sentence should be added: "Infectious diseases associated with environmental exposures or conditions are also addressed."
Human Health	37	The discussion of sensitive populations should be expanded because these populations are important in considerations of environmental health.
Ecological Condition	38	The climate indicator trends in the ecological condition chapter should be placed in a paleoclimatic context to distinguish between human induced changes and other long-term changes. References to the Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a,b) should be included.
Ecological Condition	38	A question should refer to trends in exposure and effects of contaminants in organisms rather than focusing on trends in biomarkers.
Ecological Condition	39	EPA should reorganize the ecological condition chapter to focus on three major indicator categories: Ecosystems, Ecological Processes and Services, and Ecosystem Components.
Ecological Condition	39	Appropriate indicators should be included in the ecological condition chapter to provide information on the ecosystem extent (e.g., land cover, land use, urbanization) and quality /condition (e.g., landscape integrity, connectedness, fragmentation, and contamination) of major ecosystem types.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Ecological Condition	40	Indicators should be included in the ecological condition chapter to represent important ecosystem processes and services such as: provisioning (e.g., timber, fuel, minerals, and other services); regulating (e.g., disease, climate, and flood processes); cultural (e.g., spiritual and aesthetic services); and supporting (e.g., soil formation, primary productivity, pollination, decomposition, disturbance, nutrient cycling, hydrological/chemical cycling, carbon sequestration processes, and services such as clean air, clean water, and net production).
Ecological Condition	40	Indicators should be included in the ecological condition chapter to represent physico-chemical components of ecosystems (e.g., soils, water, chemicals, snow pack, and physical habitats).
Ecological Condition	40	Indicators should be included in the ecological condition chapter to represent biological components of ecosystems ranging from the genome to the community level of organization. Such components include biodiversity, endangered species, invasive species, keystone species, and communities.
Ecological Condition	41	The discussion of "trends in diversity and biological balance of the nation's ecological systems," (on page 6-29) should acknowledge that some systems inherently have different numbers and variety of species, making it inappropriate to make comparisons between systems.
Ecological Condition	41	The discussion of "fish faunal intactness," should explain why 1970 is chosen as the reference year.

Table F-1. Recommended Changes in the Final Report

Chapter	Page	Recommendation
Ecological Condition	41	Trend data should be adjusted to account for methodological inconsistencies. For example, in the discussion of "SAV in the Chesapeake" which shows trends since 1978, the Report on the Environment states that "methods changed over the course of this study. However, data have been adjusted to account for any methodological inconsistencies." The same should have been done with other parameters that are presented as a snapshot at one time that could have shown trends.
Ecological Condition	43	It should be clearly stated that specific case studies in the Report may not be representative of a general or national situation.

Appendix G. Table of Recommended Improvements for Future Reports on the Environment

Table G-1 presents a summary of recommendations that should be considered to improve future Reports. The second column of the table provides page numbers where recommendations may be found this advisory report. Additional comments and suggestions are provided in the text of this advisory report. Detailed comments pertaining to specific indicators are included in Appendix A.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Overarching	5	A synthesis chapter should be included to fully integrate the Reports and provide an overall assessment of health and ecosystem status, trends and effects. The synthesis chapter in future reports could also analyze and discuss in more detail the connections among various related indicators.
Overarching	6	A summary section should be included after each media chapter to summarize information presented in the chapter and identify relevant emerging issues that could potentially affect human health and the environment.
Overarching	6	EPA should incorporate statistical analysis and interpretation in the reporting of all indicators. This should be part of the results presentation for each indicator. In some cases, this may involve formal statistical analyses, whereas in other cases it may involve the inclusion of additional information such as error bars around mean values.
Overarching	8	The indicators selected should be clearly related to the "big picture" fundamental questions, and not chosen just because of data availability or compliance with indicator criteria (i.e., they are the only indicators left after others have been eliminated).

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Overarching	8	EPA should consider relaxing the restrictive indicator selection criteria so that additional indicators can be included. This will enable EPA to better evaluate trends and answer questions in the Report.
Overarching	10	Each of the sections that address data gaps and limitations should be separated into clear discussions of types of limitations (e.g., geographic, statistical, data coverage, etc.)
Overarching	11	EPA should analyze the air, water, land, human health, and ecological condition indicators using appropriate airshed, watershed, and ecoregional units.
Overarching	12	EPA should identify and use, with appropriate caveats, more regional indicators and data bases to illustrate trends when national data sets are not available. The Panel notes, however, that such regional data are not a substitute for national or even representative national data and can be misleading if not carefully presented.
Overarching	13	EPA should develop clear and transparent criteria that are uniformly used for the selection of regional indicators and case studies, with the recognition that not all data will meet the criteria for these regional indicators. For example, regional indicators should have long-term well supported data sets, be of particular national or local significance, or represent an assessment approach that that could be replicated.
Air	13	The discussion provided in the response to the indoor air quality question should be expanded. The discussion of indoor air and related indicators is too limited considering the importance of the indoor environment and the amount of time spent by the population indoors. While indoor environments do not fall within the statutory mandate of EPA, exclusion of available and relevant data makes the Report incomplete.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Water	19	Additional questions should be included in the water chapter to incorporate missing information on critical habitats or thematic elements such as:1) Extent and condition of coral reefs; 2) Wastewater management information (it is recommended that EPA review available National Pollution Discharge Elimination System data for possible useful indicators); 3) Extent and condition of, and trends in, riparian zones and lake shoreline (i.e., land-water interface, where much of the biological activity occurs), and their effects on human health and the environment; and 4) More national indicators and analyses providing data and information on non-indigenous invasive species.
Water	20	Some key model aquatic systems should be identified in several ecoregions of the U.S. and data collected from these systems should be mined and analyzed in the context of questions presented in the Report.
Water	20	EPA should examine the 2004 National Research Council Report on national and global water resources and water infrastructure problems, and the importance of research in addressing them (National Research Council, 2004).
Water	22	EPA should include appropriate indicators of condition of lakes, ponds, and reservoirs.
Water	22	EPA should consider including the following important specific indicators:1) Snow pack (extent, condition, and volume); 2) Pathogens (coliforms, enteric viruses, toxins, etc.); 3) Storm water and wastewater (contaminant effects); 4) Drinking water primary contaminants (e.g., microbial indicators and pathogens: bacterial, viral or protozoan); 5) Emerging contaminants such as pharmaceutical and personal care products, nanoparticles, and others.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Water	23	Additional wetland data should be used. In many areas, wetlands will indicate more efficiently the ecological integrity of the entire watershed than will any other portion of the landscape.
Water	23	EPA should evaluate whether nutrient indicators based on bioavailable nitrogen and phosphorus or nitrogen:phosphorus ratios may be more useful.
Water	23	EPA should develop drinking water indicators based on the available data from the Agency's own databases and the consumer confidence reports released to the public annually by community water systems. Based on these data, EPA could formulate indicators that can delineate trends in drinking water quality. The water chapter should include source water monitoring data in addition to treated water quality data.
Water	23	Pathogen monitoring should be investigated as a primary indicator for water quality trends and human health effects across various water sources.
Water	23	Composite or multi-metric indicators should be complemented with single metric indicators that are easier to understand and require fewer caveats and assumptions.
Water	23	EPA should incorporate more information on specific toxic industrial chemicals for which the Agency has statutory responsibility under the Clean Water Act.
Water	23	EPA should analyze fish tissue contaminant data by different species, or at least conduct separate analyses of fish from different trophic levels or different habitats (as was done for the "lake fish tissue" indicator) to see which species (e.g., piscivores) are more likely to have higher levels of contaminants than others.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Water	25	EPA should visit (or revisit) the Agency's guidance manuals for lakes, rivers, coastal waters, and wetlands for potential data sets to fill identified data gaps.
Water	25	Long-term monitoring programs of EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S. Geological Survey's National Water Quality Assessment Program, and the National Oceanic and Atmospheric Administration's Status and Trends and Mussel Watch Programs), and of states or universities should be examined. Indicator criteria should be relaxed (within reason) to enable use of important trend data.
Water	27	EPA should utilize and build on existing databases that have been collected and existing local expertise that has been developed at benchmark sites in various ecoregions.
Water	27	EPA should give state data sets much closer scrutiny for possible inclusion. Some states have a wealth of area-specific data.
Water	28	EPA should consider the following as an example potential local/regional indicator for use in the water chapter. The State Water Resources Control Board of California is funding USGS to lead and conduct a Ground-Water Ambient Monitoring and Assessment (G.A.M.A.) program (U.S. Geological Survey, 2008) under which groundwater samples from public and private water supply wells from California are analyzed for water quality.
Water	28	In addition to the Gulf of Mexico and Long Island Sound, other places where hypoxic conditions tend to occur and are well monitored (such as Chesapeake Bay, the coastal waters off Oregon, and parts of Lake Erie) should be added to the hypoxia indicator.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Water	28	EPA should develop indicators for arid regions. In this regard the Agency should draw upon the numerous studies and data collection efforts conducted by various federal and state agencies in the western states where the climate is arid.
Water	28	A summary section should be included after each media chapter. In addition to summarizing information presented in the chapter, this section should also identify relevant emerging issues.
Land	29	EPA should consider adding a fundamental question on soil quality and conservation to the land chapter. The structure of the question could be parallel to the others in the chapter.
Land	31	EPA should: 1) consider a range of land cover classification schemes with different levels of resolution. This is necessary because the resolution of the data in the current Report is too coarse to completely answer the questions; 2) characterize land cover of all major ecosystem types, not just the forest land cover characterized the current draft of the Report; 3) adopt standard, established approaches for land use and land cover analysis to evaluate information and document trends across a range of available data sets.
Human Health	35	EPA should consider using an expanded suite of human health indicators (discussed in Section 9.0).
Human Health	35	EPA should adopt the suites of indicators that other agencies have developed, but present them in relation to environmental factors.

Table G-1. Recommended Improvements for Future Reports on the Environment

Chapter	Page	Recommendation
Human Health	37	EPA should consider making use of county-level data available from the states. All of the vital statistic data presented and used for the EPA Regional indicators can and have been scaled to the county level and excellent maps have been generated and already published in books.
Ecological Condition	42	EPA should use available information from the Agency's water quality criteria guidance manuals. The Panel notes that EPA has previously conducted a detailed review of current information and developed water quality criteria guidance manuals for lakes, rivers, and coastal waters.
Ecological Condition	43	Specific case studies using regional indicators should be selected for their ability to demonstrate the long-term trends that cannot be accomplished at the national level. It would be useful to pick well-studied sites (e.g., Lake Mendota, Lake Tahoe) where there are long-term data sets available for each region.
Ecological Condition	43	Some of the regional indicators should be expanded to become national indicators (e.g., SAV, invasive species, and harmful algal blooms).

Compilation of Comments on SAB Panel Review of EPA Report on the Environment 2007

1. Dr. Jana Milford

The panel has done a good job of addressing the charge questions and the report is generally clear. I especially like the careful way the panel has distinguished between recommendations for revising the 2007 ROE and recommendations for future reports.

p. xiv, line 40. For clarity, the panel could add a sentence to explain why comparison to drinking water MCLs is inappropriate.

p. 10, lines 44-46. Mercury may not be the best example of an environmental contaminant for which exposure on a national scale is (most) relevant, since there is substantial heterogeneity in deposition and environmental concentrations of mercury and in human exposure through fish consumption.

p. 14, lines 12-14. Support needs to be provided for the suggestion that EPA should try to link trends in stratospheric ozone levels to trends in secondary air pollution. Beyond pointing out the conceptual links, separating this effect from other factors seems likely to be a complicated and controversial exercise.

p. 14, lines 22-24. The panel should provide support for the statement that air pollution mixtures account for most health effects.

p. 14, lines 29-31. I'm not sure it's accurate to say NOx has been controlled to the point where it does not have direct health impacts. Would it be more accurate to say NOx has been controlled to the point that the existing NAAQS for NO_2 is no longer violated?

p. 15, lines 1-8. The panel should carefully consider the recommendation that EPA discuss "ongoing efforts, activities and/or programs …" This recommendation seems to go beyond the scope of the charge questions to the panel and likewise beyond the intent of the ROE.

p. 16, lines 4-16. I was confused by the suggestion that the final report should include an air toxics indicator. The version of the ROE provided to us includes a composite air toxics indicator as well as trends in several individual air toxics.

p. 18, lines 19-21. I didn't understand what was meant by "extrapolation of indicator data from national to regional to subregional scales".

p. 19, lines 17-18. I didn't understand what was meant by the suggestion that "more attention needs to be paid … to using the data to demonstrate how they have improved our understanding of the atmospheric system in the U.S."

p. 34, lines 15-27. The authors did a good job of expressing the difference of opinion among the panel members on this point.

Finally, one technical problem I found in the air chapter of the ROE is that it refers to the 24-hour PM2.5 NAAQS as 65 $\mu g\ m^{-3}$. I believe that NAAQS is now set at 35 $\mu g\ m^{-3}$.

2. Dr. Michael McFarland

In general, the Panel is commended for providing a clear and well written report summarizing its evaluation of the *Agency's Report on the Environment 2007: Science Report*. Beyond addressing the specific charge questions, the Panel's overarching or "higher level" findings are particularly timely and highlight the acute need for more effective integration, analysis and interpretation of environmental and public health indicator information. The Panel is applauded for its identification and explicit support for developing regional environmental indicators as well as the inclusion of statistical analyses of data to establish scientific confidence in indicator trends.

Given the quality and clarity of its responses, I strongly recommend the report's approval pending minor editorial corrections. The following are my responses to the specific report reviewer questions as well as a couple of general observations.

a) Were the original charge questions adequately addressed in the draft report?

The Panel's report provides full and comprehensive responses to each of the six charge questions posed by the Agency. The Panel's responses establish a clear direction for the Agency to improve both the structure and content of the current and future ROE reports.

b) Is the report clear and logical?

Overall, the report is clear and logical. However, in a few places, the report would benefit by providing additional direction to the Agency in terms of how it might sufficiently address the Panel's concerns. For example, while the Panel supports the relaxing of the restrictive indicator selection criteria so that additional indicators can be included (Page 8), it is unclear to the reader if there is an unambiguous and systematic process that could be applied to achieve a scientifically defensible set of credible environmental indicators.

To its credit, the Panel acknowledges that changes to the indicator selection process would not be simple and that the conceptual framework of the report should drive the development of indicator selection criteria. From a reader's standpoint, it would be valuable if this recommendation could be more fully developed.

c) Are the conclusions drawn and/or recommendations made supported by information found in the body of the draft SAB report?

The Panel provides conclusions and recommendation that are strongly supported by information found in the body of the report. The Panel is also commended for prioritizing its recommendations so that the Agency can effectively commit its scarce resources to those activities that will yield the largest benefit in the development of future ROE.

ADDITIONAL COMMENTS

The following comments are provided simply as observations for the Panel's consideration in completing the final draft of the report.

a) Page 31 (Line 15-18) – The report implicitly states that "biosolids and compost" are wastes applied to agricultural land. Although the confusion is understandable, from a regulatory (e.g., Clean Water Act, Resource Conservation and Recovery Act, etc.) and agricultural standpoint, biosolids and compost are not wastes but highly valued soil organic and nutritional amendments.

b) Throughout the current report, the Panel expresses a number of concerns regarding aggregation of regional indicator data to reflect national trends as well as disaggregation of national indicator data to describe regional and/or local environmental conditions. While it is not explicitly stated anywhere in the report, many, if not most, states also generate and publish their own ROE.

It is not entirely apparent from the Panel's report whether the Agency's regional environmental and public health indicator trends are simply a "roll-up" of state available ROE information from that particular region or if the information on regional indicators has been obtained independently. If state furnished information were being used to support regional indicator tends, it is important to establish whether there is mandated uniformity regarding the type and quality of environmental and public health indicators each state must use in preparing it own ROE. High

variability in individual state indicator type and quality requirements would render data aggregation a significant challenge for establishing both regional and national trends.

3. Dr. Rebecca Parkin

SAB Panel's Draft Report

Overarching comments

The Panel has drafted a thorough and balanced report, describing the strengths and limitations of the Agency's draft **Report on the Environment 2007: Science Report (ROE).** The Panel recognizes the staff's considerable effort, productivity and outputs provided in this unique report. The target audiences for the report and web-based version include scientists and the general public. The Panel's draft report indicates that, although the ROE includes extensive data and many indicators, the lack of clear objectives, unifying conceptual framework, historical contexts, statistical analyses and interpretation, and cross-chapter linkages will very likely limit the ROE's value to and use by its readers.

The Panel's draft is in large part clear, unambiguous and consistent. The report is well organized and consistently states the panel's findings in the Executive Summary, chapters and appendices. Comments most frequently made below relate to terminology (#3, 4, 6, 7 and 10), recommendations (1, 5,8, 9, 12, 17 and 18), and the Executive Summary (#2, 4, 5 and 7). One recommendation is made for the Letter to the Administrator.

Responses to the quality review questions

a) **The original charge questions to the SAB panel were adequately addressed in the Panel's draft report.** Although parts of some questions were not explicitly addressed for a few chapters, these minor gaps do not result in substantive limitations in the Panel's review and advice to the Agency. The only question entirely missed (on pp. xiii and 13) was Charge Question 6 (technical merit, clarity and communication level) for the entire draft ROE. This question can be readily answered by identifying the recurring statements among the separate chapter responses.

b) **The Panel's draft report is generally clear and logical.** Major themes are appropriately identified in the Executive Summary. Rationales for major points, such as the limited value of using EPA regions for indicators, are presented throughout the draft report (e.g., pp. 18, 26, 36 and 42). Together the rationales offer considerable support for the Panel's conclusions.

Some sections of the report could be made clearer or stronger. For example:

1. The Panel's recommendations for future ROEs, as well as the 2007 ROE, add value to their response to the Agency. However, switching back and forth between the 2007 and future ROEs can be confusing to the reader. Although Appendices F (2007 ROE) and G (future ROEs) are helpful, they do not include all of the suggestions made in the text (e.g., p. xi, line 20-22; p. 4, lines 30-32; p. 9, lines 34-37; p. 18, lines 34-36). Further, this reviewer would have preferred the use of graphic tools in the text to separate visually the recommendations for the 2007 and future ROEs. For example, "final report" could be underlined and "future reports" could be italicized.
2. P. xi, lines 20: The text on p. 13, lines 22-23 ("data …not science") is powerful and could be inserted in the Executive Summary to increase the impact of this important limitation of the entire ROE.
3. Pp. xi and 4: "Synthesizing chapter" is used in two ways – to refer to the human health and ecology chapters and to a recommended integrative chapter across the entire ROE. While the Panel very appropriately recommends greater synthesis, it may be clearer to the reader if two different terms are developed to distinguish the former two chapters in the 2007 ROE from the latter recommended chapter for future ROEs.
4. P. xii, l. 33: "Adjusting criteria" is not clear. This term is not used in reference to criteria anywhere else in the Panel's report; instead discussions of applying the criteria too rigidly (e.g., p. 8), having clear and transparent criteria (e.g., p. 13) and relaxing the criteria (e.g., pp. 8, 9 and 25) are used often in the report. Upon comparing the various sections about the criteria for indicators, this reviewer was not clear whether the Panel is concerned that the criteria in use are not appropriate or clear, the criteria are appropriate but the application of them is too rigid, the criteria should be applied in a tiered manner (e.g., classify indicators by level of confidence), or something else. The Panel's intent should be more clearly and consistently stated in the Executive Summary and throughout the report.
5. P. xvi, lines 2-16: This section does not note that the Panel suggests reorganizing this chapter to align with Figure 5.1 (see p. 33, lines 41-44). This is a fundamentally important recommendation that merits inclusion in the Executive Summary, just as reorganization of the ecological chapter is included later on the same page (p. xvi, lines 20-22).
6. P. 4, lines 3 and 7: The close use of "framework" for two different constructs is unnecessarily confusing. Changing the term in line 3 would be more expeditious, as it would not result in other changes to the text.
7. P. 15, lines 7 and 12: The word "must" is used twice here and 15 other times in the draft. This strong verbiage implies that these points are directive to the Agency and therefore belong in the Executive Summary.

If these points are not that significant, then less directive phrasing may be more appropriate wherever "must" is currently used in the draft.

8. P. 15, lines 21-28: The discussion of acid deposition and where it belongs in the ROE should be revised. As now stated, it is not clear whether the Panel is recommending that acid deposition be discussed in several ROE chapters, be addressed in one part and cross-referenced in others, or something else entirely.
9. P. 28, lines 39-40: If these recommendations are for "other parts of future reports" (presumably "each media chapter" as stated in line 43), then this recommendation should be moved to the overarching comments.
10. P. 33, l. 17 (and A-10, l. 24): The use of "interpretation" here may be confused with the statistical interpretations recommended throughout the Panel's report. Rephrasing this sentence to remove this word would be beneficial.
11. Pp. 37-38: Some text under Questions 1 and 2 provides answers to Charge Questions 2 and 3, respectively. Realignment of some text here would ensure that readers do not miss some of the Panel's responses.
12. P. 40, lines 2-12: This recommendation seems to be ambitious for the 2007 ROE. Is it actually meant for future ROEs? If not, then describe how feasible it will be for the Agency to meet this recommendation for the 2007 ROE.

c) The conclusions drawn, and/or recommendations made, are usually well supported by the information in the body of the Panel's draft report. Many examples are provided to illustrate the Panel's recommendations; e.g.:

13. P. 4: The limited value of stand-alone chapters, insufficiently linked to each other due to the lack of an overarching conceptual framework, is reinforced by comments throughout the report.
14. P. 14 and 24: The need for historical contexts to improve the ROE's value to readers is supported with arguments several times.
15. P. 16, lines 28-31: The draft ROE uses the same brief description of NEI over and over. The Panel is correct to point out this unnecessary limitation in the ROE.

A few sections would benefit from more support.

16. Pp. 14, 18, and 43: The bases for indicators and regions could be better supported in these sections.
17. P. 34, lines 12-13: This raises an issue noted in the Land comments (pp. 31, A-11 and A-12). The recommendation is not supported sufficiently here. Is the Panel suggesting that the pesticide issues need to be cross-referenced in the Land chapter or removed entirely there?
18. P. 37, lines 35-36: This recommendation is not clear. In Chapter 5, there are hundreds of keyword "hits" for at-risk subpopulations including:

children, the elderly, immune compromised, pregnant and nursing women, pre-term babies, asthmatics and people with other preexisting diseases. This recommendation needs to be supported with more explanation of the Panel's concern and how the discussion should be "expanded."

Technical errors or omissions

19. P. xv, l. 42 and p. 35, l. 33: Hospital and emergency department discharge data are available in the National Hospital Discharge Survey reports at http://www.cdc.gov/nchs/
20. P. 36, lines 36-46: Note that some states periodically publish cancer and other disease data reports that provide data on county and/or major metropolitan scales.
21. P. 37, l. 18: Datasets can be found in National Vital Statistics Reports online at http://www.cdc.gov/nchs

Suggested edits

22. P. xi, l. 9 and p. 3, l. 15: Add "respectively" after G
23. P. xi, l. 13-14: This subheading implies that the recommendations will apply to the final ROE 2007. However, many recommendations refer to future ROEs only. This reviewer suggests that the subheading be changed.
24. P. A-7, l. 12: This is not a grammatically correct sentence.
25. P. A-11, l. 3-4: Minor edits are needed at end of line 3 and beginning of line 4.

Letter to the Administrator

One major finding of the SAB panel is that the limitations of the ROE are in part due to the way indicator selection criteria are used. This reviewer believes that adding this point to the letter would highlight this concern, strengthen the letter and increase the likelihood that this issue will be addressed.

The Panel appropriately notes that the development of ROEs should be embedded in the Agency's ongoing activities.

4. Dr. Thomas Theis

I've skimmed the EPA ROE 2007 draft, and read through the SAB review. In general I think the ROE is badly flawed and the SAB has made an exemplary attempt to point out why this is so, and made several very good suggestions for improvement. Basically the ROE encourages the notion that environmental quality consists of a series of measurements of contaminants, and that the human relationship to the environment is one in which we must be "protected" (presumably from ourselves). In my opinion the Agency is missing out on a great

opportunity to use the ROE as a way to educate the public on the interdependencies that exist among environmental systems, and the dependencies of human society on ecosystem functioning. The best example, in Chapter 10 of the SAB report, is the recommendation to begin the task of measuring ecosystem goods and services, and track them over time. In this way it becomes much easier to make the case that environmental protection isn't just something we should do (e.g. because it is the "right" thing to do), it is something that is integral to human commerce and civilization, with connections to our economic as well as physical well-being. If I have a wish it is that the SAB report makes this point as forcibly and as clearly as possible.

5. Dr. Jill Lipoti

Tom: I have reviewed the SAB Advisory on the EPA's Report on the Environment 2007. I also used the links that you provided to take a look at the EPA ROE itself. I thought the panel did an excellent job of pointing out the problems with the ROE 2007, while acknowledging the importance of the ROE and encouraging the EPA to continue to produce such reports.

a) the original charge questions to the SAB Standing or Ad Hoc Committee/Panel were adequately addressed in the draft report;

Yes.

b) the draft report is clear and logical; and

I think the organization of comments chosen by the panel will make it very easy for EPA to sort the comments for response into those for particular media (air, water, land) and those which pertain to all groups.

c) the conclusions drawn, and/or recommendations made, are supported by information in the body of the draft SAB report.

Yes. I liked the discussion on page 8 regarding indicator selectivity and how the selection criteria was responsive to comments from the last SAB review, but now were seen as too restrictive and excluded indicators which may have been useful. The discussion about regional indicators will also be very useful for the Agency.

6. Dr. Judith Meyer

I commend the panel for what appears to be a thorough review of this report and well-organized responses to the charge questions. The review is clear and logical, and most recommendations were well supported by information in the review (see detailed comments below for those where I had some concerns).

I particularly appreciated the way the panel divided its recommendations into those that apply to the final version of the 2007 Report vs. those that apply to

future Reports and that they are summarized in Appendices F and G. My concern is that even with that organization, there are 52 recommendations for the final Report and 34 for future Reports. It was not apparent to me how the panel decided which recommendation fit into which category, and the relative distribution of recommendations into the two categories varied considerably by chapter. For example, air had 12 for the final Report and 1 for future Reports, whereas water had 4 for the final Report and 20 for future Reports. Does it represent different degrees of impatience of panel members? Some explanation of how the panel decided where to place each recommendation is needed. Did the panel discuss the feasibility of incorporating 52 recommendations into the Final Report – will this change it to a 2010 report instead of a 2007 Report?

My detailed comments below suggest recommendations that I think deserve to be highlighted by placement in the Executive Summary as well as suggestions for improving their clarity. In general I found the recommendations well supported by the information in the review.

DETAILED COMMENTS
Page, line number

Letter

2, 3: add climate change to the list of environmental pressures. It is included in this list presented in the Exec Sum, so it seems strange to be left out here.

Executive Summary

xi, 27: I question the statement that organization of the chapters into individual media "makes sense." In what context? It makes sense in that EPA is organized according to those stovepipes, but this perpetuates that approach, which SAB has criticized. I wholeheartedly agree with the committee's recommendation in bold (calling for the conceptual framework that illustrates the connections), but think that the statement that the organization "makes sense" is contradictory to that recommendation. It would be better to state that it is consistent with EPA's programmatic configuration rather than that it makes sense.

Review

1,36: The panel notes that this report is unique. I am somewhat confused by that statement because I am familiar with the Heinz Center's efforts at providing a report on the environment, and I am certain panel members are as well. In some cases this report appears to use some of the indicators used by the Heinz Center (this is mentioned in a discussion of flow regimes). Is there a place in the Report where this effort is placed in the context of the other on-going efforts of reporting condition of the environment? What makes this report unique?

1,44: The panel recommends (as did SAB 2004) that more resources be put toward this effort. It doesn't sound as though EPA changed anything after the first recommendation, and it is not clear that they will this time either. Was the panel given any actual data on resources put toward the 2007 report vs. the 2003 report? It would strengthen the case if those data could be included in this review. Also did the panel discuss the scale of additional resources needed? Just asking for more strikes me as very vague. 10% more? 50%? A doubling? Some ballpark estimate would strengthen the case. (And if it is provided, it should be incorporated into that recommendation in the letter and the Exec Sum.)

3, 41: "its value is limited" Actually the panel was harsher than that in saying this should not be called a science report. Why was it softened here and in the Exec Sum? And why was not that recommendation included in bold rather than just discussed in a paragraph (lines 27-33). It is a particularly telling comment.

4, 2: see earlier comment on organization making sense.

4, 12-23: The two recommendations are confusing in that they are somewhat contradictory. The first says there are analyses of status and trends, the second says that there is little trend analysis.

5, 22-24: The idea of using the figure to help organize the report and show the relationships among the different chapters at the beginning of each chapter is a great one!

7, 14-15: It was not clear what the panel was saying about the "policy relevant" questions and where they would fit in this conceptual framework.

9, 2-3: This is an excellent recommendation that deserves a place in the Executive Summary.

pp. 8-9: I was confused about how indicators were included. On p. 8, the recommendation (17-19) implies that indicators were not used if data were not available, but on p. 9 (e.g., 18-19) the review implies that the indicator was used but trends were not reported. Were indicators actually eliminated when the data requirements were not met? Or were indicators included, but no status or trend reported because data requirements were not met? Those are two different things, and the panel was not clear in what they meant by "indicators were eliminated."

10, 18-20: This first recommendation seems fundamental to the criticism of the entire review, but this is the first time I have seen it! If there is not a transparent set of indicator metrics that are well justified, that is a very important finding and one that deserves being included in an Exec Sum and Letter.

10, 21-22: This second recommendation is an excellent idea and one that deserves to be a part of the Executive Summary.

17, 5: Just a question. Are greenhouse gases included in the air chapter? If not, the panel should comment on that.

Air chapter: I am not an air expert, but I thought that Wagner's letter on light pollution had some merit. Did the panel address nighttime light at all? Was any indicator proposed to cover this?

19, 17: The recommendation on greater incorporation of the "one atmosphere" approach is excellent and deserves to be incorporated into the Executive Summary. It could be incorporated into the recommendation on xi, 31-36.

20, 27: It is not clear into what context the panel is recommending the Report be placed.

21, 1-3: What would make it adequate? Incorporation of a measure of quality? If so, that should be stated.

22, 35-45: In Appendix A (A-6) I recall reading a criticism that sediment quality was included for estuarine but not freshwater sediments. It seems that recommendation belongs in this list. Also that criticism made me wonder whether any indicator addressed sediment loads. If not, that is a glaring omission. I presume the panel discussed this.

23, 22: I find it incredible that these pathogen indicators were not included. This needs to be incorporated into the Executive Summary and could easily be done on xiv, 39 (I think that is what the panel is hinting at in this line, but why not be more direct!).

Water chapter: There was no mention in this review of any indicator addressing restoration activities (e.g., dam removals that would enhance connectivity in flowing waters) or any mention of incorporation of restoration actions in a discussion of observed trends. Did the Report contain any discussion of restoration activities? Did the panel consider this at all?

30, 1-6: This more detailed comment about developing qualitative and quantitative trends seems to apply to the whole Report and not just the land chapter. These ideas should be incorporated into the overarching section and into the trend comments in the Executive Summary.

37, 35: A mention of the need to incorporate sensitive populations surely belongs in the summary of the human health chapter in the Executive Summary.

A-5, 42: Do NOT recommend calling it "ortho-P". DIP is fine. The chemical analyses commonly used do not measure only ortho-P so it is not correct to call it that.

A-18, 21: MEA stands for Millennium Ecosystem Assessment NOT Midwest Environmental Advocates – were you guys just checking to see if we were really reading this whole document?!!! (I didn't read Appendix B)

C-2: Some of the arrows in the figure could be simplified. Clearly waste and cover/use under land also influence ecological condition, not just soil. Just draw arrows from the box as a whole to the components of the ecological condition box. The three arrows from the land box to the human health box could be combined to one arrow from the whole land box. The same applies to the two arrows from the water box to the health box.

EDITORIAL COMMENTS

LETTER

1, 23: clarify by calling it "SAB's 2004 advice"

EXECUTIVE SUMMARY

xi, 2: "its value is limited" rather than "it is limited"

xi, 44: "such conclusions and statements of significance."

REVIEW

12, 15: "connectivity analyses" would make more sense

15, 31: "in the final Report."

19-21: The comments on the water chapter are in a somewhat different format than the other chapters. They are mostly short bullets and not longer explanatory paragraphs.

E-1, 40: "completely" instead of "completed"

7. Dr. Kenneth Dickson

I think the report provides some excellent recommendations on how to improve the report. The letter to the administrator highlights the major recommendations for improvement and correctly advises the Administrator that to do an adequate job will require integrating it into the core mission –directed activities and an increased investment in resources .

The SAB Advisory panel effectively addressed their charge

The draft report was clear and logical.

The report was well organized and provides supportive information for the recommendations.

One area that I did not find addressed in the Advisory panel's report is whether or not EPA did a good job in the draft EPA Environment 2007 report of communicating with the public. I noted that one of the goals for the ROE 2007 report was "to communicate with the general public." Was the report written in a style that the general public could understand and arrive at informed conclusions about the status of the environment? Since the Advisory Panel suggested the addition of a Conclusion chapter, I suspect that the draft reviewed might not have been citizen friendly.

I noticed on the EPA website that EPA plans to produce a companion report titled Highlights of Conditions and Trends which is probably directed at the general public. However, in light of the Advisory Panel's observation that there was very little information in the report on trends and little statistical analyses of data is it appropriate to attempt to report on trends to the general public.

8. Dr. Rogene Henderson

General Comment:

I found the organization of the advisory to be excellent. I liked separating the recommendations that could be applied to the current report from those that were appropriate for consideration for future reports. I liked having the overall recommendations and the responses to the charge questions given in bold type, followed by a brief explanation. The use of the Appendices to expand on the different aspects of the report made the main body of the report more readable.

Because of my background and expertise, I have concentrated on the parts of the advisory related to the air program and to human health.

Specific Comments:

Executive Summary
1. I found the recommendations to be reasonable but had questions about two of them.
In the Executive Summary, in the discussion on indicators (page xii) there is a discussion on the need to distinguish between data gaps and data limitations. This may be true, but I do not think a clear case was made for it. This is also mentioned on page 9, lines 33-40. I think of data gaps as one of the limitations that might be discussed. In other words, "limitations" is a broader term than "data gaps." The authors need to clarify the distinction they would like to make.

2. Also in the Executive Summery, on page xiii, the statement is made that "regional data are not a substitute for national or even representative national data." But the rest of that paragraph points out the benefits of using regional data. In a country as large as the US, I think it is reasonable to expect that the data may differ drastically between regions and it would be valuable to recognize such differences. I am sure that the west will differ from the east in both status and trends. This topic is discussed in much more detail on pages 10-12, and in other places in the report, but many people will only read the Executive Summary. The recommendation in the ES needs to be clarified. What does the Panel recommend that the EPA do?

Air Chapter

This is well written and I agree with the recommendations, especially those related to emphasizing "one atmosphere."

Page 14, line 39: I am not sure I understand this sentence and would leave it out.

Page 16, lines 42-46: The use of the terms "primary pollutants" and "secondary pollutants" could be confusing. I am not sure what is meant, and the terms "primary" and "secondary " are already used in the air pollution area to refer to health versus welfare standards. Could other terms be used?

Human Health Chapter

I agree with the recommendations in this section of the advisory.

Page 35, line14: I would insert "or morbidity" after "mortality" on this line. After all, it is not just death we are concerned with.

Page 35, line 18 and following: I agree wholeheartedly with the discussion of the value of regional data found here, but it seems to contrasts with the executive summary, page xiii, lines 27-28. I think the Executive Summary should be clarified to agree with the text found in the rest of the report.

9. Dr. Virginia Dale

The report is comprehensive and very useful for the Agency. It is helpful to have specified what changes should be made to the current report as compared to future reports. The strong support for continuing and enhancing this type of reporting by the Agency is well documented and important. The report does a good job of addressing the charge questions and is clear for the most part.

I do have a few suggestions to improve the clarity and will bring a marked up hard copy to the February 28 SAB meeting in Washington.

- The report mentions climate change as being an important factor (p. x), and this environmental pressure should be added to the letter (p. ii).
- It is not clear why and is distracting that some sentences are bold in the executive summary. I suggest they not be in bold. Instead see my next suggestion to highlight important material.
- The bullets on pages xi to xiii are in different styles (some are sentences some are phrases and some are only two words). I suggest that they all be made into strong active sentences like the second bullet on page xii. They can then serve as topic sentences, which are lacking in these bulleted paragraphs.
- The sentence about significance of findings (page xi, lines 40-43) should be moved to the next bullet that deals with statistics.
- Suggested for slight wording changes and corrections to the punctuation are made on the hard copy.

Congratulations to the committee for an excellent report.

Compilation of Public Comments on the Draft SAB Report on the Environment

Panel ROE Advisory

Tom Miller
Designated Federal Officer
EPA Science Advisory Board
U.S. Environmental Protection Agency (1400F)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

February 21, 2008

Dear EPA Science Advisory Board,

I would like to talk with you briefly about the problem of light pollution in our Federal Class 1 Areas. The EPA in its October 1979, *Protecting Visibility: An EPA Report to Congress* first mentioned the problem of increased night sky brightness. Subsequent documents such as the *1982 Air Quality Criteria for Particulate Matter and Sulfur Oxides Volume III* and the *1995 Air Quality Criteria for Particulate Matter II of III* review draft also included this language. Unfortunately, it appears that the increased night sky brightness was attributed more to particulate matter than artificial lighting. As national particulate matter levels have declined, the night sky brightness has continued to increase.

Based on 1997 numbers, we have found that over half of the 149 Class 1 Federal Areas analyzed have moderate to severe light pollution problems. One-quarter of these areas have a night sky brightness so severe you can no longer see the Milky Way. Current forecasts by the National Park Service show there will be no place left in the lower 48 states with an unpolluted night sky by 2025.

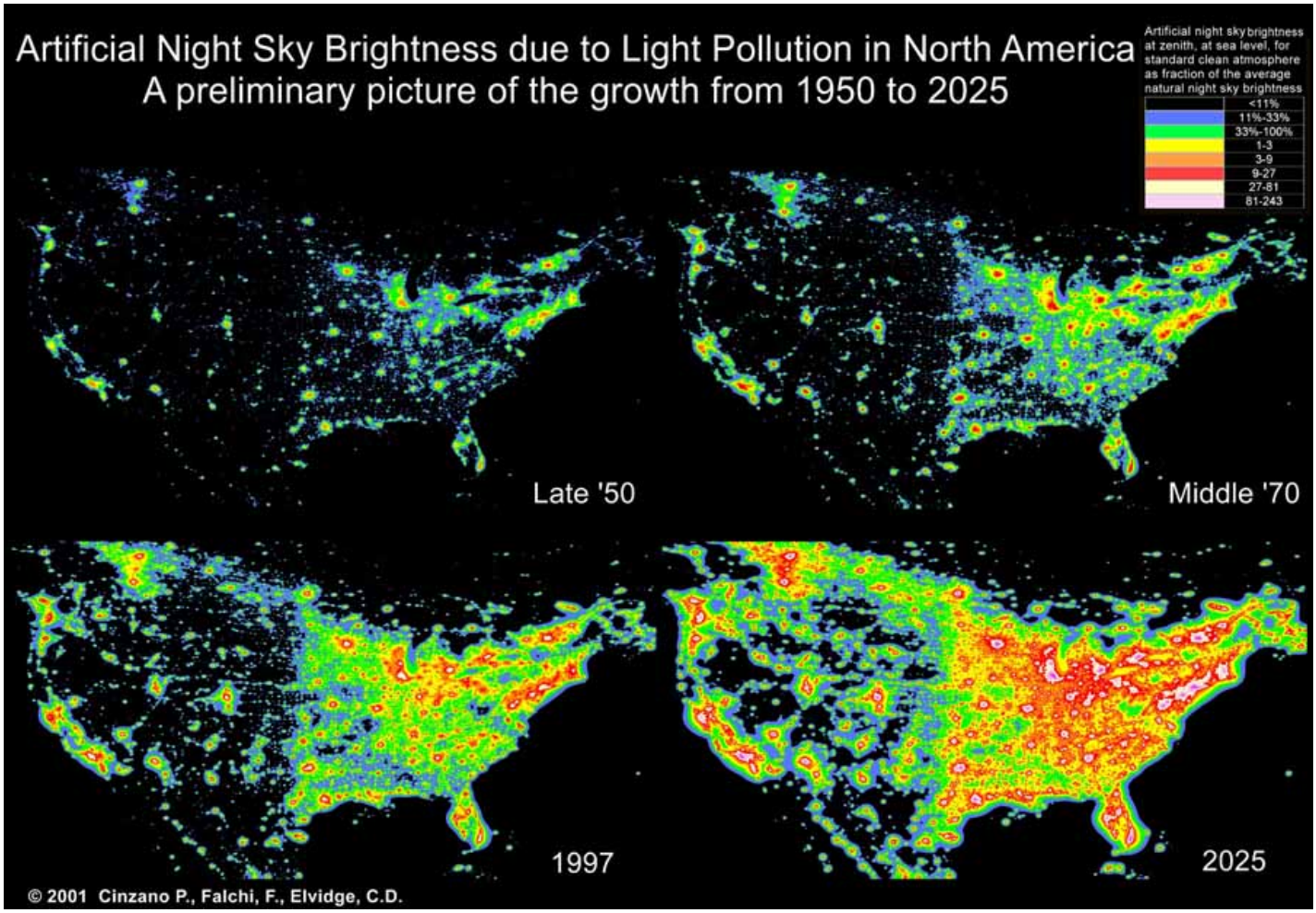
Currently, the light pollution credit in the LEED Rating System is optional and the Energy Star Program Residential Outdoor Lighting Fixture standards do nothing to discourage shining lights into the sky. Increases in lighting efficiency have historically led to more light shinning into the sky and increased night sky brightness. Although bound by the Clean Air Act's "no man-made impairment" by 2064, current programs and regulations within the EPA have not led to an improvement in the night sky brightness.

Programs such as the proposed Missouri Night Sky Protection Act offer us the ability to recognize the emission of man-made light into the skies of our protected areas is a problem and must be reduced. By treating man-made light as a nighttime visibility impairment we can work toward understanding how it can be managed. Armed with that knowledge, we can develop regulations that reduce that amount of lighting emitted into the nighttime sky above our Class 1 Federal Areas while promoting safety, conserving energy, and preserving the environment.

Listed Below is my recommended changes:

Page 2-51 (ROESAB2007-2.PDF) - Section INDICATOR: Regional Haze
Indicator Limitations
• These data represent visibility in a sampling of selected National Parks and Wilderness Areas and are not representative of other rural or urban areas.

Add this between lines 8 and 9:
• Visibility Impairment is measured and tracked using the deciview metric. The deciview metric is only valid during daylight hours. Light Pollution cannot be measured or tracked using the deciview metric so nighttime visibility impairments, principally atmospheric discoloration, remain unmonitored. Over 30 years of data on the brightness of the night sky above Federal Class 1 Areas by the Defense Meteorological Satellite Program (DMSP) indicates worsening conditions.



Reference: http://www.yosemite.org/naturenotes/NALightPollution.htm

Report on Class 1 Areas: http://www.trianglealumni.org/mcrol/class1.html

Sincerely,

Robert Wagner
9005 N Chatham Avenue
Kansas City, MO 64154
Missouri Night Sky Protection Act Homepage:
http://missourinspa.googlepages.com/

February 13, 2008

To: Dr. Deborah Swackhamer – Chair
EPA Science Advisory Board

Re: **Include Light at Night as an EPA Health Trend**

Dear Dr. Swackhamer:

I would respectfully encourage the Science Advisory Board at its February 28 meeting to amend the Review by the SAB Panel of EPA's 2007 Report on the Environment by adding a paragraph on the emerging issue of Light at Night (LAN) as a health issue.

Simply Google ***"Light at Night" health*** to see just some of the references, ranging from NIEHS reports to research studies.

Light at Night will be eventually recognized as an environmental health issue. Even a simple acknowledgement in the SAB Panel Report that LAN is an emerging trend in health that should be included in the EPA 2007 report would go a long way in establishing LAN as a credible health consideration among state and municipal governments.

I respectfully ask for your consideration and support for SAB recommending that LAN be recognized in the EPA's 2007 Report on the Environment.

Submitted by:

Leo Smith
1060 Mapleton Avenue
Suffield, CT 06078
860 668 4000

2/12/2008

Mr. Thomas Miller
EPA Science Advisory Board

Thank you for the opportunity for comment. The EPA is pursuing a laudable goal in its Report on the Environment< summarizing the key elements of ecosystem health, environmental condition, and human health. However, I point out one facet of the environment that is only briefly mentioned and deserves much more attention< that of light pollution. If not incorporated in the 2007 report, it should be critically examined by the EPA SAB for inclusion in successive reports.

Light is mentioned on page 32, ³Physical attributes of ecological systems include air temperature, light, rainfall, and sea level.² However, no further mention is made nor is the connection made between altered light regimes and artificial lighting. Even briefly giving an example on this page would be a worthwhile; something to the effect of ³For example, artificial light at night can alter habitat necessary for nocturnal wildlife.² I present several reasons below why this issue should be taken more seriously by the EPA and adopted as an Indicator:

EUR From space, the illuminated cities of the world are perhaps the first human caused environmental change one would notice. The atmosphere around cities is often lit up 2-3 orders of magnitude brighter than natural night conditions.

EUR Visible spectrum light is often dismissed as a potential pollutant or human environmental change, however it shares many characteristics of other key indicators that are accepted. Carbon dioxide is a naturally occurring molecule, yet changes to its concentration are considered alarming.

Ultraviolet radiation, like visible light, is part of the electromagnetic spectrum, but is of concern linked to ozone depletion. And, although temperature varies spatially, seasonally, and daily throughout the world, the retention of infrared radiation is currently the hottest topic in environmental news. Despite the fact that visible light is altered by human invention several fold across broad areas of the country, it receives no attention from the EPA.

EUR The Fatal Light Awareness Program estimates millions of migrating birds are killed each year due to disorientation by artificial lights. Many of these are listed species.

EUR There is a growing body of science indicating that artificial light affects a multitude of species. A sampling of these studies has been collected in Ecological Consequences of Artificial Night Lighting, by Rich and Longcore. This is particularly important considering half of terrestrial species are nocturnal and depend on darkness as a physical attribute of habitat.

EUR The visibility of stars is not only a scientific resource, but is important to many Americans. Natural night skies can be interpreted as an Air Quality Related Value under the 1977 Clean Air Act Amendments. Light pollution hinders nighttime visibility via scattered light which results in a loss in contrast. This is similar to how daytime visibility is affected by aerosols- a physical process addressed in the Clean Air Act.

EUR Artificial light at night can influence human circadian rhythms just as diminished light during the day can. Recent studies have linked altered photonic environments to breast cancer.

EUR The fraction of artificial light that causes light pollution represents a significant waste of energy, amounting to roughly 1% of total US electrical consumption.

Measurement of the brightness of the night sky is suitable as an Indicator given your criteria. It has been measured from satellites and observatories for decades, and more recently by portable ground based instruments. Methods have been peer reviewed and published, are in use by government agencies (namely NOAA, National Park Service, and NASA sponsored observatories), used by citizens and NGOs, and there is now adequate data to show trend over time. These measurements are transferable and standardized, and there is renewed interest in computer modeling of this environmental change. The EPA¹s lack of involvement in developing measurement standards should not hinder its acceptance by that agency for the purpose of understanding key elements of our changing planet.

Further information can be found at www.darksky.org, or www2.nature.nps.gov/air/lightscapes. There are a number of public individuals, scientists, and organizations interested in engaging the EPA and scientific leaders on this topic.

Sincerely,

/S/

Chad Moore< MS. Earth Science
850 S. Overland Trail #18
Fort Collins, CO 80521

International Dark-sky Association

Proposal: EPA Science Advisory Board (SAB) 2008 Workshop; Science for Environmental Protection: Directions for the Future (Date to be determined: ~September 30, 2008 ± 2-3 days)

Overview:

EPA Science Advisory Board (SAB) 2008 Workshop Science for Environmental Protection: Directions for the Future

(Date to be determined ~September 30, 2008 ± 2-3 days)

Workshop objectives

- Mark the 30-year anniversary of the federally chartered SAB by looking at past, present, and future environmental challenges and the roles of science and science advice.
- Stimulate SAB consideration of future report(s) on science priorities for meeting future challenges.

Background

The workshop will observe the 30th anniversary of the SAB, established in its current form in 1978 by the Environmental Research, Development, and Demonstration Authorization Act (ERDDAA). In addition, it will build on current advice regarding EPA's strategic research directions to look at key future science issues for EPA and approaches for addressing them.

This one-day public session will precede either a public chartered SAB advisory meeting that would allow for SAB discussion of implications of the workshop for SAB advice on EPA research needs *or* a closed SAB administrative meeting for chartered SAB discussion of implications of the workshop for future SAB practices.

Planning group formed at December 2007 SAB meeting: Drs. Granger Morgan, James Bus, Virginia Dale, George Lambert, Jill Lipoti, Jana Milford, Rebecca Parkin, David Rejeski, Joan Rose, Kerry Smith, Thomas Theis.

Proposed workshop structure (all plenary sessions)

Opening
- Welcome
- Introduction to purpose of workshop

Morning presentations and discussions:
- Three one-hour sessions devoted to science topics.
    - Format for science topic sessions:
        - 30-minute talk from an external speaker,
        - two 5-minute reflections presented by SAB members; and
        - 20 minutes of open discussion
    - Each invited speaker will discuss a major science topic and be asked to address a short list of key issues for which the SAB believes EPA will need to provide a policy response over the years 2008-2013. Speakers will be asked to talk specifically about the state of knowledge and research priorities to support policy development. Speakers will be asked to provide a list of key resources as background reading.

Lunchtime speaker addressing future science issues and globalization of science

Afternoon presentations and discussions:
- Three one-hour sessions devoted to science topics (format same as morning sessions)
- Panel discussion among past SAB Chairs on the roles of science and science advice in meeting environmental challenges
- Concluding remarks from Workshop Chair

Draft Agenda

U. S. Environmental Protection Agency Science Advisory Board (SAB) Workshop

Date to be Determined - ~September 30, 2008 ± 2-3 days

Science for Environmental Protection: Directions for the Future TBD, Washington, DC

Purpose: To mark the 30-year anniversary of the federally chartered SAB by looking at past, present, and future environmental challenges, examine the role of science and science advice and stimulate SAB consideration of the development of future report(s) on science priorities for meeting future challenges.

9:00 - 9:05	Welcome Purpose of Workshop and Agenda Overview	Dr. M. Granger Morgan, Chair, SAB
9:05 – 10:05	Air Quality	Speaker TBD SAB Members TBD, Discussants Open Discussion
10-05 – 11:05	Water Quality and Safe Drinking Water	Speaker TBD SAB Members TBD, Discussants Open Discussion
11:05 – 11:20	Break	
11:20 – 12:20	Future of Chemical Health Evaluation	Speaker TBD SAB Members TBD, Discussants Open Discussion
12:20 – 1:45	Lunch Speaker: Future Environmental Science Issues and Globalization	Speaker TBD
1:45 – 2:45	Climate	Speaker TBD SAB Members TBD, Discussants Open discussion
2:45 – 3:45	Ecosystems	Speaker TBD SAB Members TBD, Discussants Open Discussion
3:45 – 4:00	Break	
4:00 - 5:00	Sustainability	Speaker TBD SAB Members TBD, Discussants Open Discussion
5:00 – 6:00	Panel Discussion: Past, Present, and Future Directions for EPA Science and Science Advice – Views of Past SAB Chairs	SAB Chairs
6:00	Summary and Adjourn	

List of Agenda Science Topics, Likely Issues for Policy Agenda 2008-2013, Candidate Speakers

Science Topic	Likely issues for policy agenda (2008-2013)	Candidate Speakers (Final agenda would include one speaker per science topic from this candidate list
Air Quality	1. Sources and chemistry of organic aerosols 2. Global-scale transport, and material mass balance 3. Radiate properties of fine particles in the planetary energy balance 4. Likely impact of climate change on tropospheric air pollution 5. Advanced methods for air quality measurement and source apportionment	Dr. Spyros Pandis, CMU Dr. John Seinfield, Caltech
Water Quality and Safe Drinking Water	1. Watershed Reclamation and recycling (merging the CWA and SDWA) 2. Impacts of animal manure (AG) Water/ land-water interfaces 3. Climate variability and water resources (feast and famine) 4. Aquatic ecosystem disruption 5. Monitoring the water environment (emerging contaminants and water security) 6. Technology innovation (new, safe, proven, What is BAT?) 7. Consideration of water quality and quantity at multiple scales (esp. over large areas) 8. Effects of land use and land management	Dr. Sandra Batie, Michigan State University Dr. Janet Hering, Caltech Dr. David Marks, MIT Dr. Betty Olson, University of California Irvine Dr. Catherine Peters, Princeton Dr. MaryLynn Yates, University of California, Riverside.
Future of Chemical Health Evaluation	1. Given the 2007 National Academy of Sciences reports , *Toxicity Testing in the 21st Century: A Vision and Strategy* and *Applications of Toxicogenomic Technologies to Predictive Risk Assessment*, implications of a potential shift from longer-term animal assays to toxico-genomic studies 2. Impact of science on fundamental assumptions and policy positions guiding toxicity testing and risk assessment practices, such as use of Maximum Tolerated Dose (MTD) animal testing and assumption of no threshold for genotoxic carcinogens 3. Future of animal testing	Dr. John Balbus, Environmental Defense Dr. Francis Collins, Director, National Human Genome Research Institute, National Institutes of Health Dr. Leroy Hood, Institute for Systems Biology, University of Washington Dr. Daniel Krewski, University of Ottawa (Chair, NAS Toxicity Testing report) Dr. Scott Noesen, Dow Chemical.

Climate	1. What is the status of knowledge about aerosol forcing and how soon are we likely to better resolve associated uncertainties? 2. How well is down-scaling likely to work to give insight about precipitation and drought? 3. What is the current state of understand of the interaction between climate change and regional air pollution? What do we need to improve that knowledge? 4. What are we likely to be able to say about sea-level rise over the coming decade (i.e., what will it take to learn how fast we are losing Greenland ice). 5. How well will GCM's and other modeling efforts likely be able to assess the secondary and indirect impacts of possible planetary-scale geoengineering.	Dr. Rosina M. Bierbaum, University of Michigan Dr. David Keith, University of Calgary Dr. Steven Schneider, Stanford Dr. Robert Watson, World Bank
Ecosystems	1. How do ecosystem services relate to EPA mission to protect the environment? 2. How would ecosystem services be measured?	Dr. Patrick Mulholland, Oak Ridge National Laboratory Dr. Peter Groffman, Institute of Ecosystem Studies Dr. Peter Kareiva, The Nature Conservancy Dr. James R. Karr, University of Washington Dr. William Mitsch, The Ohio State University Dr. Sanjayan Muttulingam, The Nature Conservancy Dr. Mary Santelmann, Oregon State University Dr. John Wiens, The Nature Conservancy
Sustainability	1. How can the dynamic, and long-term, interactions between human societies and natural systems be incorporated into models and concepts of sustainability? 2. What are the right metrics, and how can they be determined, for characterizing sustainable policy directions? 3. On what do the vulnerability and resilience of human-natural systems depend? How are these distributed geographically and/or by specific types of ecosystems and human livelihoods? 4. Can scientifically meaningful limits be defined that would provide effective warning of conditions beyond which human-natural systems incur significant risk of serious	Dr. Paul Anastas, Yale University Mr. Ray Anderson, Interface Carpet Dr. Heriberto Cabezas, Chief, Sustainable Environments Branch, USEPA, Cincinnati Dr. William Clark, Harvard University

	degradation? 5. What types of incentive methodologies--including markets, rules and regulations, and norms--can most effectively improve social capacity to guide human-natural systems on more sustainable trajectories? 6. How can today's monitoring and measurement methods for environment and society be integrated and extended to provide better guidance for more sustainable policy decisions? 7. How can today's relatively independent activities involving research, planning, observation, assessment, and decision support be better integrated into systems for adaptive management and societal learning?	Dr. Gretchen Daily, Stanford University Dr. Thomas Graedel, Yale University Dr. Robert Kates, Initiative on Science and Technology for Sustainability (ISTS) Mr. William McDonough, Stanford.

Anastas,Paul

Yale University

Dr. Paul Anastas is a Senior Research Fellow at Harvard's Center for International Development, Director of the Green Chemistry Institute in Washington, D.C., and a Roy Fellow at the Environment and Natural Resources Program at Harvard's Kennedy School of Government. He was Assistant Director for Environment at the White House Office of Science and Technology Policy (OSTP) from 1999-2004 where his responsibilities covered a wide range of environmental science issues including furthering international public-private cooperation in areas of science for sustainability such as Green Chemistry. Anastas served as the Chief of the Industrial Chemistry Branch of the U.S. Environmental Protection Agency (EPA) from 1989-1998. During that period he was responsible for regulatory review of industrial chemicals under the Toxic Substances Control Act and the development of rules, policy and guidance. In 1991, he established the industry-government-university partnership Green Chemistry Program, which was expanded to include basic research, and the Presidential Green Chemistry Challenge Awards. Prior to joining the EPA, he worked as an industrial consultant to the chemical industry in the development of analytical and synthetic chemical methodologies. Anastas received his MA and PhD in Organic Chemistry from Brandeis University and his BS in Chemistry from the University of Massachusetts at Boston.

Anderson,Ray

Interface, Inc.

Mr. Ray Anderson founded Interface, Inc. in 1973, a commercial floor covering company that produced America's first free-lay carpet tiles. He served as co-chairman of the President's Council on Sustainable Development during the Clinton administration; was recognized by Mikhail Gorbachev with a Millennium Award from Global Green in September 1996; receivedin 1996 the Ernst & Young Entrepreneur of Year for the Southeast Region and in 1997 as the Georgia Conservancy's Conservationist of the Year. Mr. Anderson's honors also include the prestigious George and Cynthia Mitchell International Prize for Sustainable Development, presented in 2001; the SAM-SPG Sustainability Leadership Award of 2001; the U.S. Green Building Council's Inaugural Leadership Award, 2002; and the National Wildlife Federation Conservation Achievement Award for Corporate Leadership, 2002. Mr. Anderson was named a Senior Fellow and Leading Voice for Green and Sustainable Design by the Design Futures Council in 2003, and also received the IIDA Star Award. In 2004, he was honored with the National Ethics Advocate Award from The Southern Institute for Business and Professional Ethics. In 2005 he received the Harvard Business School Atlanta Alumni Club's Community Leadership Award, as well as a Corporate Ally Award from Possible Woman Enterprises. Mr. Anderson is an industrial engineer and graduate of the Georgia Institute of Technology. He serves on the boards of The Natural Step, USA; The Georgia Conservancy; Upper Chattahoochee Riverkeeper; Ida Cason Callaway Foundation; Rocky Mountain Institute; the University of Texas Center for Sustainable Development, and is an honorary advisor to the President of Peking University. He holds honorary doctorates from Northland College (public service), LaGrange College (business), N.C. State University (humane letters) and University of Southern Maine (humane letters).

Balbus,John

Environmental Defense

A physician and public health professional, Dr. John Balbus works and consults on a broad range of environmental health issues, including air pollution, built environment and health, climate change, nanotechnology, toxicology, and antibiotic resistance. Prior to joining Environmental Defense, Dr. Balbus was on the faculty at the George Washington University Schools of Medicine and Public Health and Health Services, where he was founding director of the Center for Risk Science and Public Health and founding co-director of the Mid-Atlantic Center for Children's Health and the Environment. Board certified in both Internal and Occupational and Environmental Medicine, Dr. Balbus combines experience as a clinician with expertise in environmental health sciences. He is currently a member of the National Academy of Science Board on Environmental Studies and Toxicology, the Institute of Medicine Roundtable on Environmental Health Sciences, Research and Medicine, and the EPA Children's Health Protection Advisory Committee.He holds an M.P.H. from Johns Hopkins University; M.D., University of Pennsylvania; A.B., Harvard University.Recent publications include "Transportation and Health" (book chapter in Environmental Health, from Global to Local, Frumkin H., ed., 2005); "Getting it Right the First Time: Developing Nanotechnology While Protecting Workers, Public Health and the Environment" (Annals New York Academy of Sciences, 2006); "Ushering in the new toxicology: toxicogenomics and the public interest" (Environmental Health Perspectives, 2005); and "Human Health and Global Climate Change: A Review of Potential Impacts in the United States" (Prepared for the Pew Center on Global Climate Change, December 2000).

Batie,Sandra

Michigan State University

Dr. Batie has been the Elton R. Smith Professor in Food and Agricultural Policy, in the Department of Agricultural Economics at Michigan State University since 1993. She received her baccalaureate degree in economics from the University of Washington in 1967, and earned her M.S. and Ph.D. degrees at Oregon State University in agricultural economics with a specialty in natural resource economics, graduating in 1973.Dr. Batie research projects include (a) implementation of agro-environmental water quality standards, (b) corporate environmental management strategies in the agricultural sector and (c) examining the influence of agricultural contractual arrangements on producer's financial and environmental performance. Dr. Batie has served on committees of the National Academy of Science, Board of Agr iculture, and the Office of Technology Assessment; and she was a trustee of both Winrock International and the International Rice Research Institute. She is currently Chairman of the Board of Trustees of Winrock International. Dr. Batie has also traveled internationally with different delegations; her most recent trips have been to Nicaragua, Western Europe, and Africa. She has served on the Board of Directors and as president of both the American Agricultural Economics Association and the Southern Agricultural Economics Association.

Bierbaum,Rosina

University of Michigan

Dr. Rosina Bierbaum currently serves as the vice chair of the United Nations Scientific Expert Group on Climate Change; as a trustee of the University Corporation for Atmospheric Research (UCAR); and as a board member for the American Association for the Advancement of Science; the Federation of American Scientists; the Energy Foundation; and the Environmental and Energy Study

Institute. She is also a member of the International Advisory Board for the journal "Frontiers in Ecology and the Environment"; the National Research Council's Board on Atmospheric Sciences and Climate; the Design Committee for the Heinz Center's "The State of the Nation's Ecosystems" project, the Selection Committee for the Tyler Prize; the Aldo Leopold Leadership Program advisory committee, and the advisory board for the National Ecological Observatory Network (NEON). On campus, she co-chairs the University of Michigan's Sustainability Task Force, chairs the Deans' Council of the Graham Environmental Sustainability Institute, and is part of the oversight committee developing a certificate program in Science, Technology and Public Policy. Governor Granholm appointed her to serve on the State's Task Force on Chronic Wasting Disease in Cervids in 2003.She received a Ph.D. Ecology and Evolution, 1985, State University of New York, Stony Brook;; B.S. Biology, 1974, B.A. English, 1974, Boston College.

Cabezas,Heriberto

EPA

Dr. Heriberto Cabezas is Chief, Sustainable Environments Branch, Sustainable Technology Division, National Risk Management Research Laboratory, U.S. Environmental Protection Agency. Research activities include leadership of the Sustainability Theory Research Team involving the development of a mathematical theory of sustainable systems drawing on principles from physics and ecology and development of a model food web including a Lotka-Voterra type mathematical model for the population dynamics of the system. Development of a hypothesis for a criteria defining sustainable systems based on Information Theory.He holds a Ph.D. in Chemical Engineering, University of Florida (1985); M.S. in Chemical Engineering, University of Florida (1981); and B.S. in Chemical Engineering (Magna Cum Laude), New Jersey Institute of Technology (1980) .

Clark,William

Harvard University

Dr. William C. Clark is the Harvey Brooks Professor of International Science, Public Policy, and Human Development. Trained as an ecologist, his research focuses on the interactions of environment, development, and security concerns in international affairs. Clark is coauthor of Adaptive Environmental Assessment and Management and coeditor of Sustainable Development of the Biosphere; The Earth as Transformed by Human Action; Learning to Manage Global Environmental Risks; and Global Environmental Assessments: Information and Influence. Clark is a member of the U.S. National Academy of Sciences and cochaired the National Research Council study on Our Common Journey: A Transition Toward Sustainability. He chairs the environmental reporting program of the Heinz Center for Science, Economics, and the Environment, which produces a periodic report on The State of the Nations Ecosystems. Clark is a recipient of the MacArthur Prize, the Humboldt Prize, and the Kennedy School's Carballo Award for Excellence in Teaching.

Collins,Francis

National Human Genome Research Institute

Dr. Collins earned a B.S. in chemistry at the University of Virginia in 1970 and a Ph.D. in physical chemistry at Yale University in 1974. He then enrolled in medical school at the University of North Carolina, where he earned an M.D. in 1977. From 1978 to 1981, Collins served a residency and chief residency in internal medicine at North Carolina Memorial Hospital in Chapel Hill. He then returned to

Yale, where he was named a Fellow in Human Genetics at the medical school from 1981 to 1984. During that time, he developed innovative methods of crossing large stretches of DNA to identify disease genes.He joined the University of Michigan in 1984 and later became Professor of Internal Medicine and Human Genetics,. In 1993, Dr. Collins became director of the National Center for Human Genome Research, which became NHGRI in 1997. As director, he oversees the International Human Genome Sequencing Consortium. In 1994, Collins founded NHGRI's Division of Intramural Research (DIR), an intramural program of genome research that has developed into one of the nation's premier research centers in human genetics.

Daily,Gretchen

Stanford University

Dr. Gretchen C. Daily is Bing Interdisciplinary Research Scientist in the Department of Biological Sciences at Stanford University. An ecologist by training, Dr. Daily is working to develop a scientific basis - and political and institutional support - for managing Earth's life support systems. Her efforts span basic science, environmental policy analysis, teaching, and public education. Dr. Daily's primary scientific efforts concern the future course of extinction, the resulting changes in the delivery of ecosystem services, and novel opportunities for biodiversity conservation. She is developing ways of forecasting changes in biodiversity and certain ecosystem services, based on countryside biogeography (with her own field sampling mostly in Costa Rica and Mexico), remote sensing, and theoretical modelling. With other scholars, Dr. Daily is also developing an interdisciplinary framework for evaluating and influencing human impacts on the environment. The framework integrates key aspects of the natural and social sciences, especially economics.Dr. Daily was granted the Frances Lou Kallman Award for Excellence in Science and Graduate Study (1992). She was then named a Pew Fellow in Conservation and the Environment (1994), a fellow of the Aldo Leopold Leadership Program (1999), and a recipient of the 21st Century Scientist Award (2000). She has served on a subcommittee of the Presidential Committee of Advisors on Science and Technology (1997-98) and on numerous other panels and committees for the United Nations, the World Bank, private foundations, and scientific institutions.Dr. Daily has published over 100 scientific and popular articles. Her third book, coauthored with Katherine Ellison, is in press (The New Economy of Nature: The Quest to Make Conservation Profitable, Island Press, Washington, D.C.). Her other books are Nature's Services: Societal Dependence on Natural Ecosystems (Daily, G., Ed., 1997, Island Press) and The Stork and the Plow: The Equity Solution to the Human Dilemma (Ehrlich, P., A. Ehrlich, and G. Daily, 1995, Putnam Press).

Graedel,Thomas

Yale University

Dr. Thomas E. Graedel is Clifton R. Musser Professor of Industrial Ecology, and a professor in the departments of chemical engineering and geology and geophysics. In the 11 books and over 250 technical papers he has authored or coauthored, Graedel has provided both the perspective and techniques to help industrial operations design processes and manufacture products in such a way as to minimize and optimize their environmental interactions. These include the textbook "Industrial Ecology," first published in 1995 and soon to be released in an expanded second edition; three related books -- "Design for the Environment," "Industrial Ecology and the Automobile" and "Streamline Life-Cycle Assessment; and "Atmosphere, Climate, and Change," which won the American Meteorological Society's Louis J. Battan Author's Award in 1995. He is coauthor of the forthcoming book "Atmospheric Corrosion." Graedel's

environmental assessment matrix, which he developed for AT&T Bell Laboratories, is now a standard industrial tool for streamlined life cycle assessments of the environmental impacts of products, processes and facilities. With colleagues, he has also characterized regional and global cycles for such technologically important resources as copper and zinc, and his techniques for developing cycles for the stocks and flows of materials provide a new basis for assessments of resource sustainability, environmental impacts over time and related policy initiatives. A graduate of Washington State University, Graedel earned an M.A. in physics from Kent State University and an M.S. and Ph.D. in astronomy from the University of Michigan. He was a member of AT&T Bell Laboratories' technical staff from 1969 to 1996 and was named a "Distinguished Member" of the staff in 1984. Graedel has been a named lecturer at Washington State University, York University in Toronto, the University of Virginia and the University of Florida. A member of numerous professional organizations, he is a fellow of Pierson College.

Groffman,Peter M.

Institute of Ecosystem Studies

Dr. Peter M. Groffman is currently a Senior Scientist at the Institute of Ecosystem Studies in Millbrook, NY; with research interests in ecosystem, landscape and microbial ecology, with a focus on carbon and nitrogen dynamics. He received his Ph.D in 1984 in Ecology from the University of Georgia. Specific recent research efforts include investigation of; the effects of atmospheric nitrogen deposition on nitrogen gas fluxes (EPA STAR Grant), nitrate dynamics in riparian buffer zones (USDA NRICGP, EPA), snow depth as a regulator of soil freezing and nitrogen dynamics (NSF), effects of a whole watershed calcium addition on soil nitrogen and carbon cycling (NSF), carbon and nitrogen cycling in urban watersheds and ecosystems (NSF LTER) and the effects of exotic earthworm invasion on soil nitrogen and carbon cycling (NSF). Groffman is a member of the Steering Committee for the Workshop on Advanced Approaches to Quantify Denitrification (NSF funded), the U.S. National Committee for Soil Science, the Hubbard Brook Research Foundation Nitrogen Scientific Working Group, the NOAA Gulf of Mexico Hypoxia Nutrient Reduction Workgroup, the Working Group on Aquatic Terrestrial Biogeochemistry at the National Center for Ecological Analysis and Synthesis (NCEAS), the Working Group on Trace Gas Fluxes at NCEAS, and the Expert Group on N2O and CO2 Emissions from Agricultural Soils, IPCC-Organization for Economic Cooperation and Development (OECD) Programme on National Greenhouse Gas Inventories. He was a lead author for the Second (Wetlands) and Third (North America) Assessment Reports of the Intergovernmental Program on Climate Change (IPCC). He currently serves on the editorial boards of Ecology and Ecosystem and was chair of the Soil Ecology section of the Ecological Society of America from 1997 – 98 and the Wetland Soils Section of the Soil Science Society of America from 2002 - 2003.

Hering ,Janet

California Institute of Technology

Dr. Janet Hering is Executive Officer for Keck Laboratories and Professor of Environmental Science & Engineering at California Institute of Technology. Her research interests include: biogeochemical cycling of trace metals and metalloids: microbial redox cycling; field studies of metal redox cycling, mobilization, and sequestration; mineral weathering and reactions at mineral surfaces: mechanisms and kinetics of dissolution and precipitation reactions; macroscopic, spectroscopic, and modeling studies of sorption processes; and water treatment processes for removal of inorganic contaminants: role of sorption in contaminant removal; design of novel sorbents.She

holds a Ph.D., Massachusetts Institute of Technology; A.M. Harvard University, and A.B., Cornell University.

Hood,Leroy

Institute for Systems Biology

Dr. Leroy Hood's research has focused on the study of molecular immunology, biotechnology, and genomics. His professional career began at Caltech where he and his colleagues pioneered four instruments — the DNA gene sequencer and synthesizer, and the protein synthesizer and sequencer — which comprise the technological foundation for contemporary molecular biology. In particular, the DNA sequencer has revolutionized genomics by allowing the rapid automated sequencing of DNA, which played a crucial role in contributing to the successful mapping of the human genome during the 1990s. In 1992, Dr. Hood moved to the University of Washington as founder and Chairman of the cross-disciplinary Department of Molecular Biotechnology. In 2000, he co-founded the Institute for Systems Biology in Seattle, Washington to pioneer systems approaches to biology and medicine. Most recently, Dr. Hood's lifelong contributions to biotechnology have earned him the prestigious 2004 Biotechnology Heritage Award, and for his pioneering efforts in molecular diagnostics the 2003 Association for Molecular Pathology (AMP) Award for Excellence in Molecular Diagnostics. In 2006 he received the Heinz Award in Technology, the Economy and Employment for his extraordinary breakthroughs in biomedical science at the genetic level. In 2007 he was elected to the Inventors Hall of Fame (for the automated DNA sequencer). He has published more than 600 peer-reviewed papers, received 14 patents, and has co-authored textbooks in biochemistry, immunology, molecular biology, and genetics and is just finishing a text book on systems biology. In addition, he coauthored with Dan Keveles a popular book on the human genome project-The Code of Codes. Dr. Hood is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Institute of Medicine and the National Academy of Engineering. Indeed, Dr. Hood is one of 7 (of more than 6000) scientists elected to all three academies (NAS, NAE and IOM). Dr. Hood has also played a role in founding more than 14 biotechnology companies, including Amgen, Applied Biosystems, Systemix, Darwin and Rosetta. He is currently pioneering systems medicine and the systems approach to disease.

Kareiva,Peter

The Nature Conservancy

Dr. Peter Kareiva's career spans 20 years as a university professor and 3 years working on salmon conservation for NOAA Fisheries. His past publications and research have concerned such diverse fields as mathematical biology, fisheries science, insect ecology, risk analysis, genetically engineered organisms, agricultural ecology, population viability analysis, behavioral ecology, landscape ecology, and global climate change. Peter maintains connections with several universities, and still advises students, as well as teaching courses on occasion. Dr. Kareiva's scientific research at TNC focuses on exploring conservation's unintended consequences and how to remedy them. In addition, Dr. Kareiva is exploring the development of credible tools that allow routine consideration of nature's assets (or ecosystem services) in a way that informs the choices we make everyday at the scale of local communities and regions, all the way up to nations and global agreements. He holds a Pd D from Cornell University in Ecology and Evolutionary Biology. He currently holds the position of Chief Scientist & Director of Science at The Nature Conservancy.

Karr,James R

University of Washington

Dr. James R. Karr is professor of aquatic and fishery sciences, professor of biology, and adjunct professor of civil and environmental engineering, environmental health, and public affairs at the University of Washington, Seattle. He received his Ph. D. in ecology from the University of Illinois, Urbana-Champaign. He held faculty appointments at Purdue University, University of Illinois, and Virginia Tech University and was deputy director and acting director at the Smithsonian Tropical Research Institute in Balboa, Panama. He has taught and done research in tropical forest ecology, ornithology, stream ecology, watershed management, landscape ecology, conservation biology, ecological health, and science and environmental policy. He is a fellow in the American Association for the Advancement of Science and the American Ornithologists' Union and received the 2004 Carl R. Sullivan Fishery Conservation Award from the American Fisheries Society and the 2005 Environmental Stewardship Award from the North American Benthological Society. He has written more than 300 scholarly articles, books, reports, book reviews, and popular essays on ecology and environmental policy. He developed the index of biotic integrity (IBI) to directly evaluate the effects of human actions on the health of living systems. His current primary concern is to improve the use of biological information in the decision making process of society. Protection of the well-being of human society requires more sophisticated use of ecological, especially biological, knowledge to protect human society from the effects of ecological decline.

Kates,Robert

Initiative on Science and Technology for Sustainability (ISTS)

Dr. Robert Kates trained as a geographer and taught geography for many years at Clark University in Worcester, MA, USA. He also participated in interdisciplinary programs addressing both environment and development at the University of Dar as Salaam in Tanzania, Clark University, and at the World Hunger Program at Brown University in Providence, Rhode Island, USA. Kates now serves as a Research Associate at Harvard and co-convener of the Steering Group for the Initiative on Science and Technology for Sustainability. Kates served as chair of the Coordinating Committee on a Transition toward Sustainability following the National Academy of Sciences' report, Our Common Journey: A Transition Toward Sustainability. His current research is on long-term trends and values, attitudes and beliefs affecting a sustainability transition -- e.g., see "What is Sustainable Development? Goals, Indicators, Values, and Practice" (Kates et al., 2005) and "Do Global Attitudes and Behaviors Support Sustainable Development?" (Leiserowitz, Kates and Parris, 2005). His most recent books include the co-authorship of Great Transition: The Promise and Lure of the Times Ahead (2002), and with the AAG Global Change in Local Places Research Group, Global Change in Local Places: Estimating, Understanding, and Reducing Greenhouse Gases (2003).

Keith,David

University of Calgary

Dr. David Keith works near the interface between climate science, energy technology and public policy. His technical and policy work addresses the capture and storage of CO2, the economics and climatic impacts of large-scale wind power, the use of hydrogen as a transportation fuel, and the technology and implications of geoengineering. Keith has served as a member of several advisory boards and panels including Canada's 'blue ribbon' Panel on Sustainable Energy Technology (report) and as a member of U.S. National

Academy committees. He currently serves on Canada's Capture and Storage Task Force, and is one of the world's energy experts named by national science academies to the InterAcademy Council study on Transitions to Sustainable Energy Systems. Keith has addressed technical audiences with articles in Science and Nature; he has consulted for national governments, industry and environmental groups, and has reached the public through national media in Canada and the U.S. As an undergraduate, Keith took first prize in Canada's national physics prize exam. As a graduate student, he won MIT's biennial departmental prize for excellence in experimental physics, and most recently he was named Environmental Scientist of the Year by Canadian Geographic in 2006 (article). Keith spent most of his career in the U.S. at Carnegie Mellon, Harvard and the National Center for Atmospheric Research. He returned to Canada in 2004 to build a research group on energy and environmental systems in Calgary, Alberta.

Krewski,Daniel

University of Ottawa

Dr. Daniel Krewski is currently Professor of Medicine and Professor of Epidemiology and Community Medicine at the University of Ottawa, where he is involved in a number of activities in population health risk assessment within the new Institute of Population Health. Dr. Krewski has also served as Adjunct Research Professor of Statistics in the Department of Mathematics and Statistics at Carleton University since 1984. Prior to joining the Faculty of Medicine at the University of Ottawa in 1998, Dr. Krewski was Director, Risk Management in the Health Protection Branch of Health Canada. Dr. Krewski joined the Health Protection Branch of Health Canada in 1972, and has extensive experience with a wide variety of health protection issues, particularly in relation to food safety and environmental health. While with Health Canada, he also served as Director of the Bureau of Chemical Hazards and as Chief of the Biostatistics Division in the Environmental Health Directorate. Dr. Krewski obtained his Ph.D. in statistics from Carleton University and subsequently completed an M.H.A. at the University of Ottawa. His professional interests include epidemiology, biostatistics, risk assessment, and risk management. Dr. Krewski is a Fellow of the American Statistical Association and the Society for Risk Analysis. Dr. Krewski has contributed to over 300 publications in the scientific and technical literature, and is author or editor of five books. He is currently an Associate Editor of Risk Analysis, Risk Abstracts, and the Journal of Epidemiology and Biostatistics. Dr. Krewski has been a member of a number of expert panels on health risk assessment, including committees established by the American Health Foundation, the International Life Sciences Institute, the the International Programme on Chemical Safety. From 1992 to 1996, Dr. Krewski served as the Canadian representative on the Scientific Council of the International Agency for Research on Cancer. He currently serves as a member of the Board on Environmental Studies and Toxicology within the U.S. National Academy of Sciences, and has recently been appointed Chair of the Royal Society of Canada's Expert Panel on the Potential Health Risks of Exposure to Radiofrequency Fields from Wireless Telecommunications Devices.

Marks,David

MIT

Dr. David Marks received his Ph.D. in Environmental Engineering from the Johns Hopkins University. His expertise is in how large-scale infrastructure systems are organized and managed, with special concern for anticipating and mitigating larger scale, environmental and economic impacts. Much of Dr. Marks' work is based on large-scale computer-based simulation and optimization modeling to help

illuminate conflicts between competing objectives, goals, interest groups, and governmental organization. This work led to contributions in large-scale environmental systems, multi-objective analysis under uncertainty, and in new methods for increasing the interaction between scientific and technical knowledge and the difficult, diffuse, decision-making process involved in environmental management. Within the United States, he has been instrumental in work on large-scale infrastructure renewal, the clean up of hazardous wastes, and the provision of safe drinking water.Dr. Marks has worked closely with groups at MIT in the understanding of the interface between science, technology and society. This includes being a former director and co-director of MIT's Laboratory for Energy and the Environment and a founding member of the Technology, Management and Policy Program and MIT's Engineering Systems Division. He teaches and advises in the MIT Technology and Policy Program.

McDonough,William

William McDonough + Partners

Mr. William McDonough is a world-renowned architect and designer and winner of three U.S. presidential awards: the Presidential Award for Sustainable Development (1996), the National Design Award (2004); and the Presidential Green Chemistry Challenge Award (2003). Time magazine recognized him as a “Hero for the Planet” in 1999, stating that “his utopianism is grounded in a unified philosophy that – in demonstrable and practical ways – is changing the design of the world.” Mr. McDonough has been a leader in the sustainable development movement since its inception. He designed and built the first solar-heated house in Ireland in 1977 while still a student at Yale University and designed the first "green office" in the U.S. for the Environmental Defense Fund in 1985. Mr. McDonough was commissioned in 1991 by the City of Hannover to write The Hannover Principles: Design for Sustainability, the official design guidelines for the 2000 World's Fair, which the City presented to the 1992 U.N. Earth Summit in Brazil. He and German chemist Dr. Michael Braungart co-authored Cradle to Cradle: Remaking the Way We Make Things (North Point Press, 2002), which has now been published in German, Italian, Spanish, Chinese, and Korean translations. The two were also the subject of a 2001 documentary video, The Next Industrial Revolution, from Earthome Productions.Mr McDonough is founder and principal of two design firms. William McDonough + Partners, Architecture and Community Design, has created numerous landmarks of the sustainability movement since 1981, designing homes, offices, corporate campuses, academic buildings, communities, and cities. McDonough Braungart Design Chemistry (MBDC) employs a comprehensive Cradle to Cradle design protocol to chemical benchmarking, supply-chain integration, energy and materials assessment, clean-production qualification, and sustainability issue management and optimization. Mr. McDonough and his firms have received numerous national and international architectural, environmental, industrial and design awards for their work.A recognized leader in sustainable design and development, Mr. McDonough writes and speaks extensively on his design philosophy and practice. Mr. McDonough is Consulting Professor of Civil and Environmental Engineering at Stanford University, U.S. Chair of the Board of Councilors of the China-U.S. Center for Sustainable Development, and Chair of the Board of Overseers for the Center for Eco-Intelligent Management at the Instituto de Empresa in Madrid. He is a board member for The H. John Heinz III Center for Science, Economics and the Environment, as well as the Management Committee of HRH The Prince of Wales’s Business & The Environment Programme at Cambridge University. Mr McDonough is a venture partner with VantagePoint Venture Partners, a $2.8 billion global technology venture capital firm with a dedicated CleanTech practice group. From 1994-1999, Mr. McDonough was the Edward E. Elson Professor of Architecture and Dean of the School of Architecture at the University of Virginia.

Mitsch,William

The Ohio State University

Dr. William Mitsch is a professor of natural resources and environmental science and director of the Olentangy River Wetland Research Park at The Ohio State University in Columbus. In 2004, Professor Mitsch and Dr. Sven Erik Jørgensen, a professor of environmental chemistry at the Danish University of Pharmaceutical Sciences in Copenhagen, Denmark, were awarded the Stockholm Water Prize for their pioneering development and global dissemination of ecological models of lakes and wetlands, widely applied as effective tools in sustainable water resource management. Their theoretical and applied work on lake and wetland ecosystems, management of lake and wetland water quality, and lake, river and wetland conservation, restoration and usage has been acknowledged and implemented in both developing and developed countries.Dr. Mitsch was the inspiration behind the Olentangy River Wetland Research Park at The Ohio State University, a world-class wetland research and education facility. There, among other focus areas, research on the ecological restoration of the Mississippi-Ohio-Missouri Basin is being spearheaded. To help reduce coastal pollution in the northern Gulf of Mexico, the ultimate depository of the Mississippi, he has also taken the role as leader in the debates, studies and resolutions dealing with coastal wetland losses in the U.S. state of Louisiana. He has also shown that constructed wetlands can be engineered for use as buffering and purification systems, as has Dr. Jørgensen, who for the last nine years has been responsible for a project in Tanzania to develop better knowledge of such systems. In practical terms, artificial wetlands can be ideal for use as an inexpensive, final stage in the domestic wastewater treatment process – an approach which could have significant meaning for the developing world.

Muttulingam,Sanjayan

The Nature Conservancy

Dr. Sanjayan completed his Ph.D at the University of California, Santa Cruz, where he did his thesis work on genetics and demography with Dr Michael Soule, one of the founding fathers of the field of Conservation Biology. After a short stint at the World Bank, Sanjayan joined The Nature Conservancy in 1999, first as the Director of Science for the California Program, and later was named one of three Lead Scientists for the organization as a whole. Dr. Sanjayan's past work has focused on conservation genetics, conservation planning, wildlife corridors, wildlife sampling, conservation policy, and conservation measures. He has a faculty appointment at University of Montana where he occasionally teaches graduate seminar classes. Sanjayan's current interest focuses on two areas: First, Sanjayan's work attempts to understand the complex relationship between poverty alleviation and conservation and how some basic services provided by nature (ecosystem services) play a role in both human well-being and conservation. Second, Dr. Sanjayan works with scientists and conservationists in Africa to develop a better understanding of poorly known ecoregions and of specific threats such as climate change and private land development that pose significant challenges to successful conservation. He is currently a lead scientist at The Nature Conservancy.

Noesen,Scott

Dow Chemical Company

Jim Bus will provide Dr. Noesen's biosketch. 2/26/08

Olson,Betty

U.C. Irvine

Dr. Betty Olson's research expertise is in molecular techniques, as well as the microbiology of drinking and waste waters. Her interests cover the use of molecular biological techniques to optimize wastewater treatment, the study of microorganisms of public health importance in environmental waters, and how microorganisms influence water quality. Prior to joining the Civil and Environmental Engineering department, Dr. Olson was a professor in the Department of Environmental Health, Science, and Policy and Environmental and Community Medicine at UC Irvine. She writes: "My interests focus on molecular biological techniques and microorganisms of public health importance and on how these organisms relate to water quality and environmental clean-up. My primary focus over the last several years has been concerned with bacteriological quality of drinking and environmental waters. Another focus of interest centers on the transformation and translocation of organic and inorganic pollutants in soil and aquatic environments. My laboratory is currently investigating molecular methods of differentiation between human and animal E. coli; the effect of recharging with waters of debilitated quality on assimilable organic carbon levels in surface waters; analysis of soil microbial community structure using classical and molecular methods. "Dr. Olson holds a:Ph.D. in Environmental and Biomedical Sciences, University of California, Berkeley; M.S., Environmental and Biomedical Sciences, University of California, Berkeley; and B.S., Biological Sciences, University of California,

Pandis,Spyros

Carnegie Mellon University

Dr. Spyros Pandis is the Elias Professor of Chemical Engineering and Engineering and Public Policy in Carnegie Mellon University. He received a Diploma for the University of Patras in Greece in 1986 and a Ph.D from the California Institute of Technology in 1990. Both degrees are in Chemical Engineering. He joined the faculty of Carnegie Mellon University in 1993. His research includes theoretical and experimental studies of atmospheric chemistry as it relates to urban and regional pollution, acid rain and topics related to global climate change. Professor Pandis has published more than 80 reviewed articles and a book on atmospheric chemistry and air pollution. He is the recipient of the US National Science Foundation Career Award (1995), the Ladd Award for Excellence in Research (1995), the Benjamin Teare Award for Excellence in Education (1998) and the Ken Whitby Award (2000). He has served in NRC committees reviewing Air Quality Management in the US and the DOE office of Fossil Energy air quality research. He is currently the Principal Investigator of the Pittsburgh EPA Particulate Matter Supersite Project.

Peters,Catherine

Princeton University

Dr. Catherine A Peters holds a Ph.D. from Carnegie Mellon University in Civil Engineering, Engineering and Public Policy. Her research interests focus on Geological storage of CO2 in deep saline aquifers and the geochemical reactions that are important in this context, reactive transport modeling and pore-scale network modeling to simulate geochemcial reactions and reaction rate upscaling in porous media, the impacts of stress on microbiological metabolic processes. Stress induced by exposure to xenobiotic chemicals such as

environmental pollutants and Biodegradation kinetics for polycyclic aromatic hydrocarbons, and the relationships between molecular properties and these kinetics. Currently, Dr. Peters is the Associate Dean of Academic Affairs at the School of Engineering and Applied Science at Princeton University.

Santelmann,Mary

Oregon State University

Dr. Mary Santelmann is currently the Director of the Water Resources Graduate Program and Research Faculty at the Department of Geosciences Oregon State University. Academically, she holds three degrees: PhD in Ecology University of Minnesota, Minneapolis, MN, M.S. in Biology University of Michigan, Ann Arbor, MI and B.S. in Botany University of Minnesota, Minneapolis, MN (Honors College). In addition to her affiliation at the Water Resources Graduate Program, she is a member of International Association for Landscape Ecology, American Water Resources Association, Society of Wetland Scientists, British Ecological Society, Ecological Society of America and The Nature Conservancy. Her current research includes Ecosystem response to human land use and management practices; Environmental and anthropogenic influences on species composition and species richness in agricultural, urban and wetland ecosystems and Ecology and biogeochemistry of wetlands and riparian systems.

Schneider,Stephen

Stanford University

Dr. Stephen H. Schneider is a professor in the Department of Biological Sciences, a Senior Fellow at the Center for Environment Science and Policy of the Institute for International Studies, and Professor by Courtesy in the Department of Civil and Environmental Engineering at Stanford University since September, 1992. He was honored in 1992 with a MacArthur Fellowship for his ability to integrate and interpret the results of global climate research through public lectures, seminars, classroom teaching, environmental assessment committees, media appearances, Congressional testimony, and research collaboration with colleagues. He has served as a consultant to Federal Agencies and/or White House staff in the Nixon, Carter, Reagan, Bush Sr., Clinton and Bush Jr. administrations. He also received, in 1991, the American Association for the Advancement of Science/ Westinghouse Award for Public Understanding of Science and Technology, for furthering public understanding of environmental science and its implications for public policy. In 1998 he became a foreign member of the Academia Europaea, Earth and Cosmic Sciences Section. He was elected Chair of the American Association for the Advancement of Science's Section on Atmospheric and Hydrospheric Sciences (1999-2001). Schneider was elected to membership in the U.S. National Academy of Sciences in April 2002. Schneider's current global change research interests include: climatic change; global warming; food/climate and other environmental/science public policy issues; ecological and economic implications of climatic change; integrated assessment of global change; climatic modeling of paleoclimates and of human impacts on climate, e.g., carbon dioxide "greenhouse effect" or environmental consequences of nuclear war. He is also interested in advancing public understanding of science and in improving formal environmental education in primary and secondary schools. He was a Coordinating Lead Author in Working Group II of the Intergovernmental Panel on Climate Change (IPCC) (under the auspices of the World Meteorological Organization and the United Nations Environment Program) from 1997-2001, and was a Lead Author in Working Group I from 1994-1996. He was also a lead author of the IPCC guidance paper on uncertainties. He is currently a co-anchor of the

Key Vulnerabilities (including Article 2) Cross-Cutting Theme for the Fourth Assessment Report (AR4) of the IPCC.

Seinfeld,John

California Institute of Technology

Dr. John Seinfeld is the Louis E. Nohl Professor and Professor of Chemical Engineering at the California Institute of Technology. He received his Ph.D. in Chemical Engineering from Princeton University and joined the faculty at Caltech in 1967. His honors and awards include the elected membership in the National Academy of Engineering, 1982; Fellow of the American Academy of Arts and Sciences, 1991; Award for Creative Advances in Environmental Science and Technology, American Chemical Society, 1993; the Fuchs Award, International Aerosol Research Assembly, 1998; the Warren K. Lewis Award, American Institute of Chemical Engineers, 2000; and the Nevada Medal, 2001. He is the recipient of honorary doctorates from the University of Patras (Greece) and Carnegie Mellon University. He leads the John Seinfeld Research Group which conducts research in atmospheric science that involves laboratory experiments, field measurements, and theoretical modeling.

Watson,Robert

University of East Anglia

Dr. Robert Watson joined the World Bank as Senior Scientific Advisor in the Environment Department in 1996, became Director of the Environment Department and Head of the Environment Sector Board in 1997 and is currently the Chief Scientist and Senior Adviser for Sustainable Development. Dr Watson received a PhD in Chemistry from London University in 1973. He has received awards for his contributions to science, including the American Association for the Advancement of Science Award for Scientific Freedom and Responsibility in 1993 and the insignia of Honorary Companion of St Michael and St George from the British Government in 2003. Prior to joining the World Bank, Dr Watson was Associate Director for Environment in the Office of the President of the United States in the White House and prior to that, Director of the Science Division and Chief Scientist for the Office of Mission to Planet Earth at the National Aeronautics and Space Administration (NASA).He was Chairman of the Global Environment Facility's Scientific and Technical Advisory Panel from 1991 to 1994, Chair of the Intergovernmental Panel on Climate Change (IPCC) from 1997 to 2002 and Board co-chair for the Millennium Ecosystem Assessment from 2000 to 2005. He is currently Director of the International Assessment of Agricultural Science and Technology for Development and co-chair of the International Scientific Assessment of Stratospheric Ozone. He has been Chair or co-chair of other international scientific assessments, including the IPCC Working Group II, the United Nations Environment Programme/World Meteorological Organization (UNEP/WMO), and the UNEP Global Biodiversity Assessment.

Wiens,John

The Nature Conservancy

Following degrees from the University of Oklahoma and the University of Wisconsin-Madison (M.S., Ph.D.), he joined the faculty of Oregon State University and, subsequently, the University of New Mexico and Colorado State University, where he was a University Distinguished Professor. His work, which has emphasized landscape ecology and the ecology of birds and insects in arid environments, has led to over 200 scientific papers and 7 books. John left academia in 2002 to join The Nature Conservancy as a Lead Scientist, with

the challenge of putting years of classroom teaching and academic research into conservation practice in the real world. His current scientific work at TNC addresses the critical issue of conservation in a rapidly changing world – “conservation futures.” Most conservation aims to protect and maintain the places that plants and animals need in order to persist and flourish. But these places and the surrounding environments are undergoing extraordinary changes. Climate change, economic globalization, changing land use, and increasing demands on natural ecosystems to provide goods and services are changing the ways in which people relate to nature, and conservation must adapt to this changing context. He is currently a lead scientist at The Nature Conservancy.

Yates,Marylynn

UC Riverside

Dr. Marylynn Yates conducts research in the area of water and wastewater microbiology. Her research focuses on assessing the potential for the contamination of water by human pathogenic microorganisms. As the intentional use of reclaimed water and biosolids (which may contain pathogenic microorganisms) increases, it is necessary to understand the potential impacts of these practices on public health. Specific areas of research include: 1) developing and improving methods to detect microorganisms in environmental samples (e.g., water, wastewater. biosolids, and soil) using both traditional cultural methods as well as molecular methods such as immunomagnetic separation polymerase chain reaction; 2) developing methods to assess the vulnerability of ground water to fecal contamination using bacteriophages; 3) examining the factors that control the persistence of pathogenic microorganisms in the environment; 4) assessing the potential for microbial contamination of ground water using both laboratory soil columns and field tracer studies; 5) assessing the efficacy of water, wastewater, and biosolids treatment processes to inactivate pathogenic microorganisms; and 6) assessing the potential for the use of mathematical models to predict the survival and transport of microorganisms in soil-water systems. She holds her Ph.D from The University of Arizona, 1984. Presently, Dr. Yates is Professor of Environmental Microbiology at UC Riverside.

Invitees

- SAB Staff Office has budget to support 50 SAB, CASAC, and Council travelers and other invited guests from outside the Washington DC area

- Invited Participants (Including Chartered SAB Members and SAB Committee Members) to include

    - SAB members (FY 2008 and 2009)
    - CASAC Members (FY 2008 and 2009)
    - Speakers
    - Past SAB Chairs
    - Others to be added, as resources permit, identified by the planning group from the sectors below:
        - other federal agencies
        - other federal advisory committees
        - scientific advisory committees from other countries or international organizations
        - state and local governments
        - non-governmental organizations
        - professional associations
        - think-tanks
        - trade associations and private sector
        - academic institutions and centers

Schedule Leading to Workshop

	Task	**By when**
1.	Obtain concurrence from Chartered SAB on general plan	February 28, 2008
2.	Extend invitation from SAB chair to speakers and set workshop date based near end of fiscal year (~September 30, 2008 ± 2-3 days), based on speakers' availability	March 30, 2008
3.	Secure facility and arrange logistics	April 15, 2008
4.	Follow-up with invited speakers to request the following information by mid- September before the workshop - request short biosketch - request short abstract for talk - request list of key source materials for workshop participants - request slides for presentation 1 week before workshop	April 30, 2008
5.	Issue formal invitations to other attendees	April 30, 2008
6.	Design materials for attendees	May 30, 2008
7.	Arrange travel	June-July 2008
8.	Assembly of workshop materials and provision of any reading material provided by speakers before the workshop	September 18, 2008

Strategy for Documenting the Workshop

- Planning Group will seek opportunities for a news item in *Environment, Science & Technology* or *Environmental Health Perspectives* and explore other opportunities for news items that would have a broader audience.

- SAB Staff Office-developed workshop report

    - Format:

    1. Workshop Background and Objectives
    2. Speakers biosketches, abstracts and slides presentations from talks, brief summary of discussion of questions and answers
    3. Brief summary of past chairs' panel discussion

    Appendices

    List of key resources provided by workshop speakers for each major agenda topic

Attachment O

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

February 7, 2008

Memorandum

Subject: Draft Report: Preparing for Environmental Disasters

From: Deborah Y. Dietrich, Director //s//
Office of Emergency Management

To: Tom Miller
Science Advisory Board

Thank you for the opportunity to comment on the draft report "Preparing for Environmental Disasters." While we found the report to be academically thoughtful and interesting, it does not reflect the extensive amount of work we have conducted in the past building on our lessons learned from actual responses and the work we currently have under way to prepare for environmental disasters. Since our meeting in June we have accelerated our work under the National Approach to Response and we are also working with the Department of Homeland Security (DHS) on many of the recommendations that are contained in your report. We have coordinated our comments with the Office of Homeland Security and we think it would be beneficial to arrange a meeting with the Science Advisory Board to discuss our comments. I am providing some information below about our current activities as general comments for your consideration in advance of a meeting.

- The draft report should mention the Administrators Homeland Security (HS) Priority Work Plan. The HS Work Plan was developed in 2007 to identify desired end states for preparedness and response to potential environmental disasters. This work plan is helping the Agency to be better prepared to manage both natural and man-made environmental disasters. In the evolution of the Work Plan, EPA offices are identifying key gaps in knowledge, research, tools, and funding.

- EPA is an active participant with the Department of Homeland Security (DHS) in their efforts to fulfill their mission to coordinate the government –wide preparedness planning efforts. For example, EPA was fully engaged in the development of the new National Response Framework that was published in January of this year. Related to these efforts, EPA actively participates as a member of the Incident Management Planning Team (IMPT). The IMPT is conducting detailed planning related to the National Planning Scenarios. EPA also participates in oversight of the work of the IMPT through representation on the White House Homeland Security Council's Domestic Readiness Group.

- In 2006, EPA OSWER prepared an Emergency Response Business Plan which among other things included an assessment of EPA activities under five of the DHS planning scenarios and an initial estimate of resources that would be required. Recently, as part of the development of an agency-wide National Approach to Response (NAR) implementation plan, these estimates have been revised by a workgroup comprised of regional and headquarters staff. Currently, regional workgroups are developing regional response plans using these estimates for each of the five scenarios. Through this process, they will be identifying additional resources and gaps. This information will be used by headquarters in the development of the agency wide plan.

- OEM is developing and deploying a comprehensive emergency management data architecture known as the Emergency Management Portal (EMP). The central module of the Emergency Management Portal is the Site/Environmental Assessment module. It will allow us to collect data from the field for sites (i.e., emergency responses, removals, events and exercises) on a daily basis. The data can then be moved from the field to the internal database and then to the public, as needed. Other modules that have been developed or are under development include equipment and personnel tracking, and a comprehensive decontamination portal for specific agents of concern. OEM is also working with OEI on extracting data from the Facility Registry System and integrating that data with the EMP.

- OEM is working closely with the Regions on establishing telecommunication standards and ensuring the appropriate equipment is purchased by the emergency response and removal community. A longer-term telecommunications strategy is also under development to continue to ensure national consistency, needed redundancy, and to address upcoming needs.

- Recognizing the real need to increase national lab capacity in response to large scale emergency events, EPA is establishing an all media, e.g., soil, air, and water, environmental Laboratory Response Network (eLRN) to address environmental laboratory analytical gaps for chemical warfare, biological and radiological agents. The eLRN will leverage existing laboratory networks and capabilities, and upgrade and expand additional capabilities to ensure that EPA has sufficient capacity and capability to meet its responsibilities for large scale incidents.

- OEM has established a formalized approach which includes the Agency Special Teams and On Scene Coordinators to set priorities for Homeland Security Research. OEM is establishing a tracking system and a vetting process for all research related to Homeland Security.

- EPA is implementing its Crisis Communication Plan and has formed a Crisis Communication Workgroup that is co-chaired by the Office of Public Affairs and the Office of Emergency Management. The workgroup is currently working on a companion resource guide that will include message maps, fact sheets and templates for

communication of sampling data, job aids, and other tools to assist the public information staff during response.

- Finally, we have a technical clarification. Under Section 4 – Geographically Specific Tools for Data Display and Analysis – Water Sentinel efforts have been replaced with the Water Security Initiative. WSI consists of five general components:
    - Enhanced physical security monitoring,
    - Water quality monitoring,
    - Routine and triggered sampling of high priority contaminants,
    - Public health surveillance, and
    - consumer complaint surveillance

As you can see, we are conducting an extensive amount of preparedness work and continue to modify our processes and procedures following large scale incidents and exercises. Please let me know of a time that would be convenient for us to meet to further discuss the draft report. Thank you for sharing this draft with us.